WL-TR-97-6005

FEDERAL LABORATORY CONSORTIUM'S CATALOG OF MIDWEST REGION TECHNOLOGY RESOURCES

Edison Industrial Systems Center
Toledo, Ohio

DECEMBER 1994

FINAL REPORT FOR PERIOD 3 APRIL 1991 - 3 MAY 1993

PLANS AND PROGRAMS DIRECTORATE
WRIGHT LABORATORY
AIR FORCE MATERIEL COMMAND
WRIGHT-PATTERSON AFB OH 45433-7523

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This is the second component of the Federal Laboratory Linkages - Midwest Region Demonstration Project, sponsored by the Federal Laboratory Consortium--Midwest Region, the Edison Industrial Systems Center, and the Great Lakes Industrial Technology Center. This catalog is an in-depth portrait of federal laboratories and facilities in the FLC Midwest Region.

Each listing provides a contact name and address, a description of the lab or facility and research activities, information regarding unique equipment or facilities, a listing of unique personnel, and a list of current cooperative Research and Development Agreements (CRDAs or CRADAs) and patents for license. Laboratories are not listed alphabetically under their respective departments. In addition, technology transfer intermediaries are listed by state in a separate section.

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the Great Lakes Industrial Technology Center

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Introduction

Welcome to the Federal Laboratory Consortium's Midwest Region Catalog of Technology Resources. This is the second component of the Federal Laboratory Linkages - Midwest Region Demonstration Project, sponsored by the Federal Laboratory Consortium—Midwest Region, the Edison Industrial Systems Center, and the Great Lakes Industrial Technology Center. This catalog is an in-depth portrait of federal laboratories and facilities in the FLC Midwest Region.

Each listing provides a contact name and address, a description of the lab or facility and research activities, information regarding unique equipment or facilities, a listing of unique personnel, and a list of current Cooperative Research and Development Agreements (CRDAs or CRADAs) and patents for license. Laboratories are listed alphabetically under their respective departments. In addition, technology transfer intermediaries are listed by state in a separate section.

Following this introduction, you will find a matrix which is intended to make this reference catalog easy to use. The technologies used in this matrix were chosen based on a compilation of several listings of key technology areas critical to U.S. industrial competitiveness in the future. When using the matrix, the general technology areas appear along the side of the matrix and the federal laboratories listed in this catalog appear across the matrix. If you are interested in seeing the general types of research being conducted at a particular laboratory, look down the page; if you wish to see all laboratories working in a general area, look across the page. In the pages following the matrix, the general technology areas are described in more detail to assist users of this reference in pin-pointing laboratories more clearly. A complete index at the back of this reference catalog will also aid in locating more detailed information.

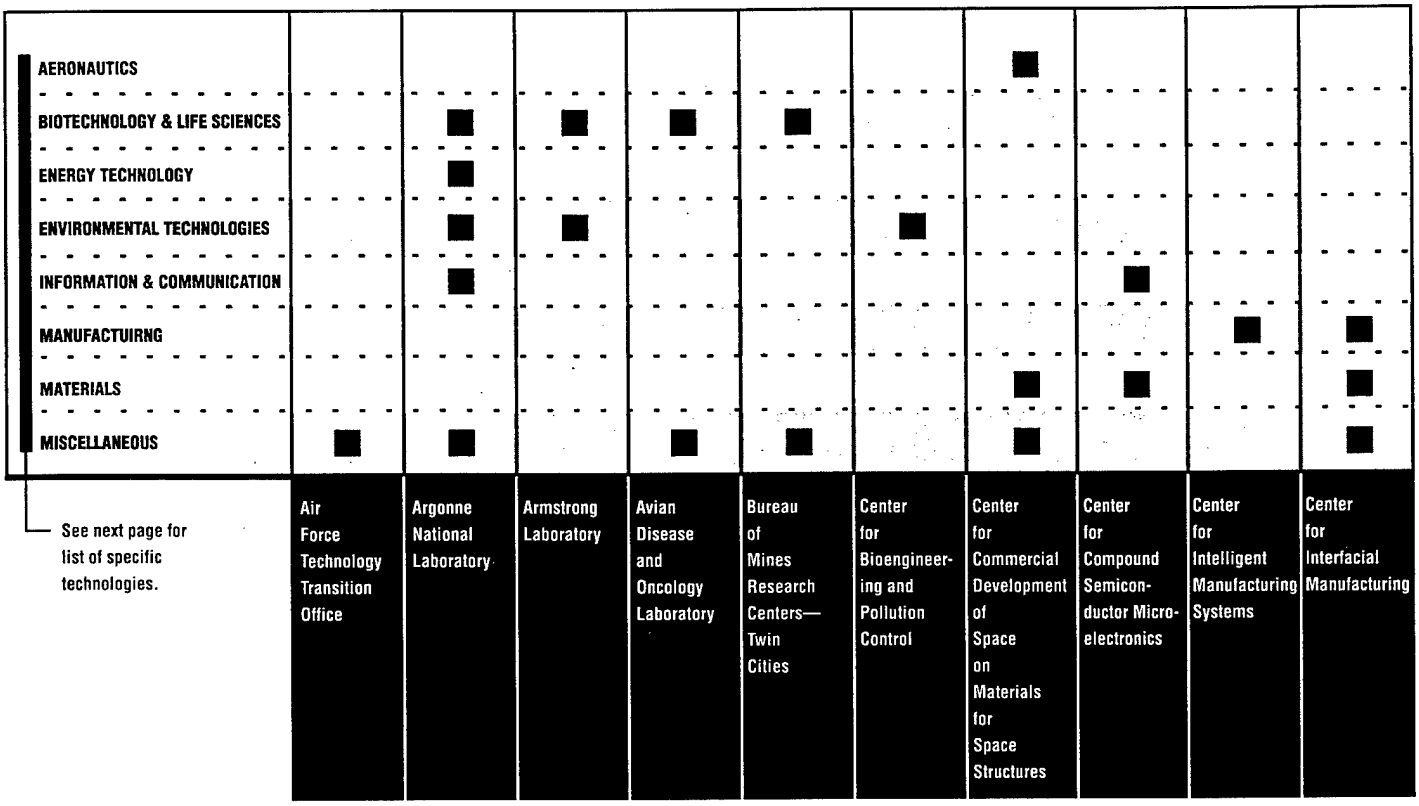
The information contained in this catalog was compiled from published federal sources and was approved by each laboratory and facility listed. A review committee, comprised of Mr. Charles Alter, Dr. William Coggin, Dr. Tim Janis, Dr. Joe Ray, Dr. Phil Roberts and Mr. Ted Schoenborn, reviewed the Catalog analyzing it for usability and readability. The primary purpose of this catalog is to assist technology transfer intermediaries, whether in industry, federal labs or other state and regional programs, in their task of facilitating technology transfer. The catalog's companion, the Midwest Region Federal Laboratories Executive Reference, is an excellent resource for the businessperson seeking a brief description of the 18 main laboratories information.

We hope this catalog will help you in your technology transfer endeavors.

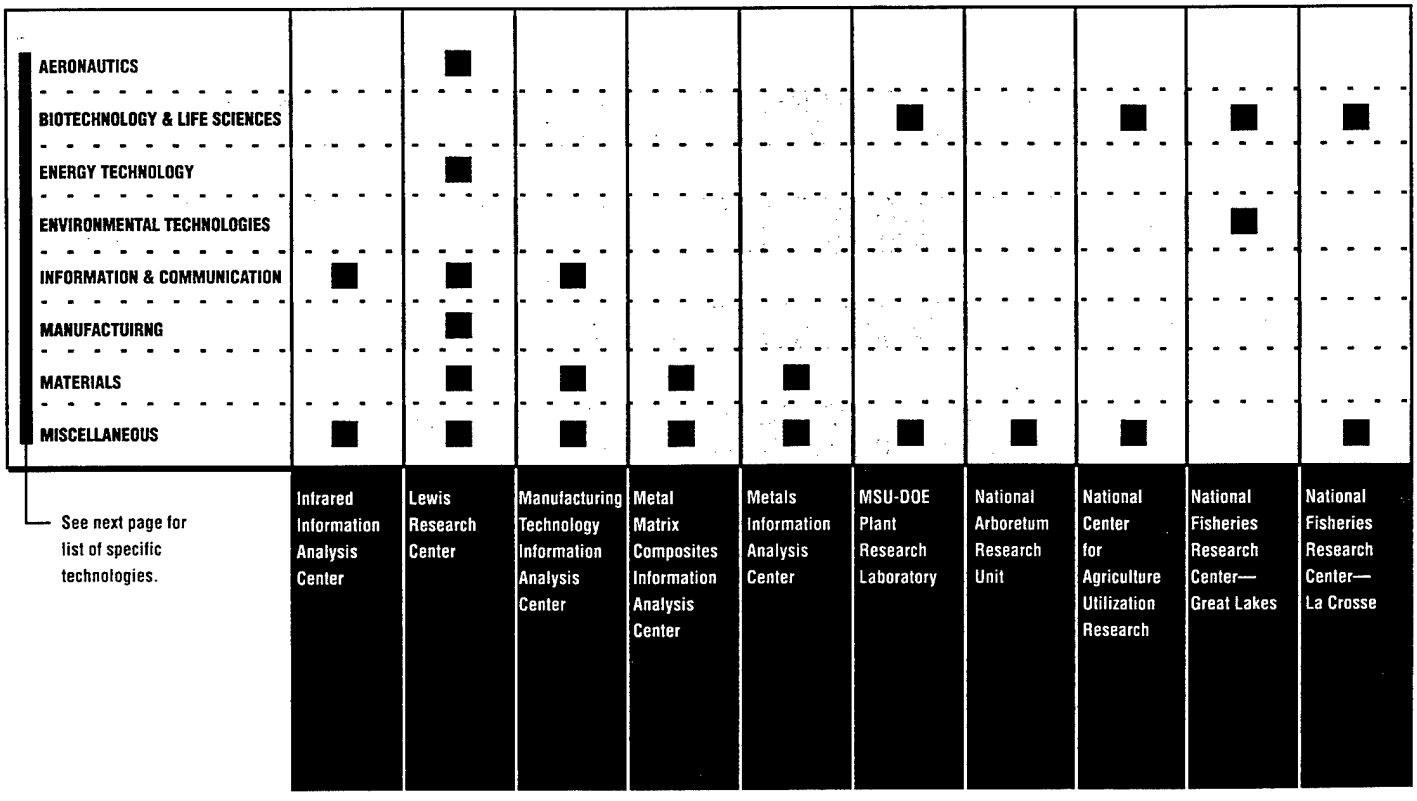
EISC

Great Lakes
Industrial Technology Center

TECHNOLOGIES MATRIX



See next page for list of specific technologies.



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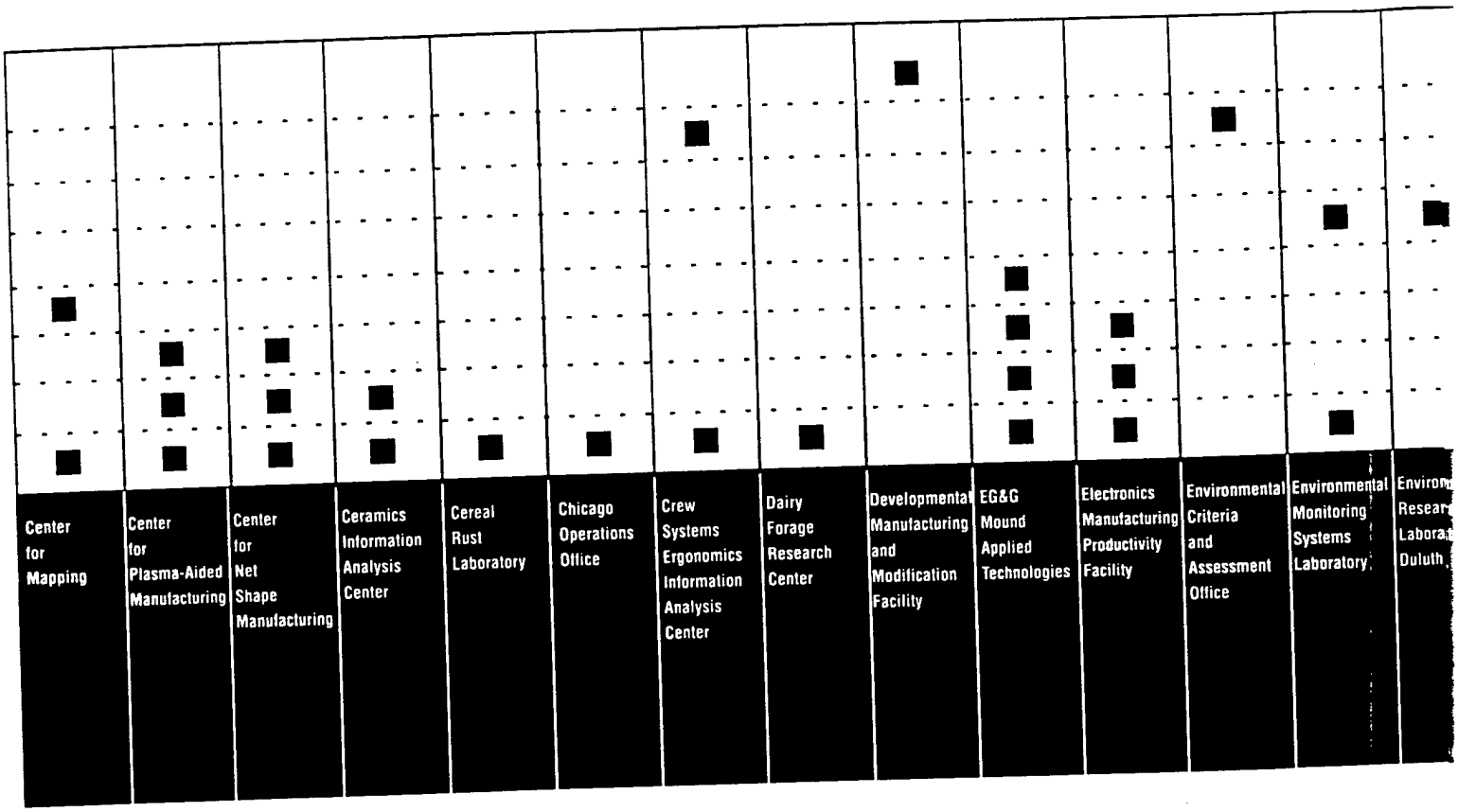

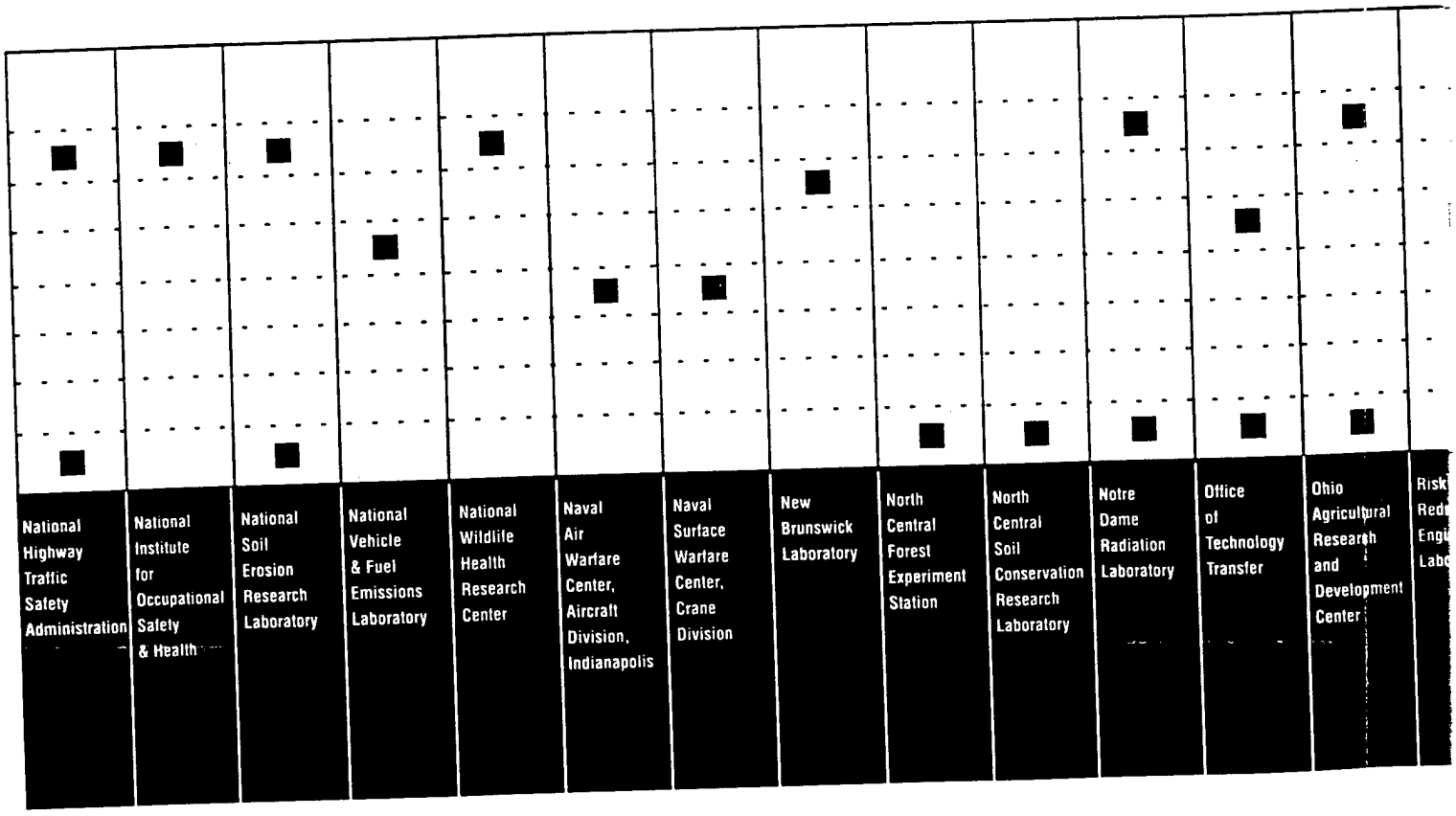

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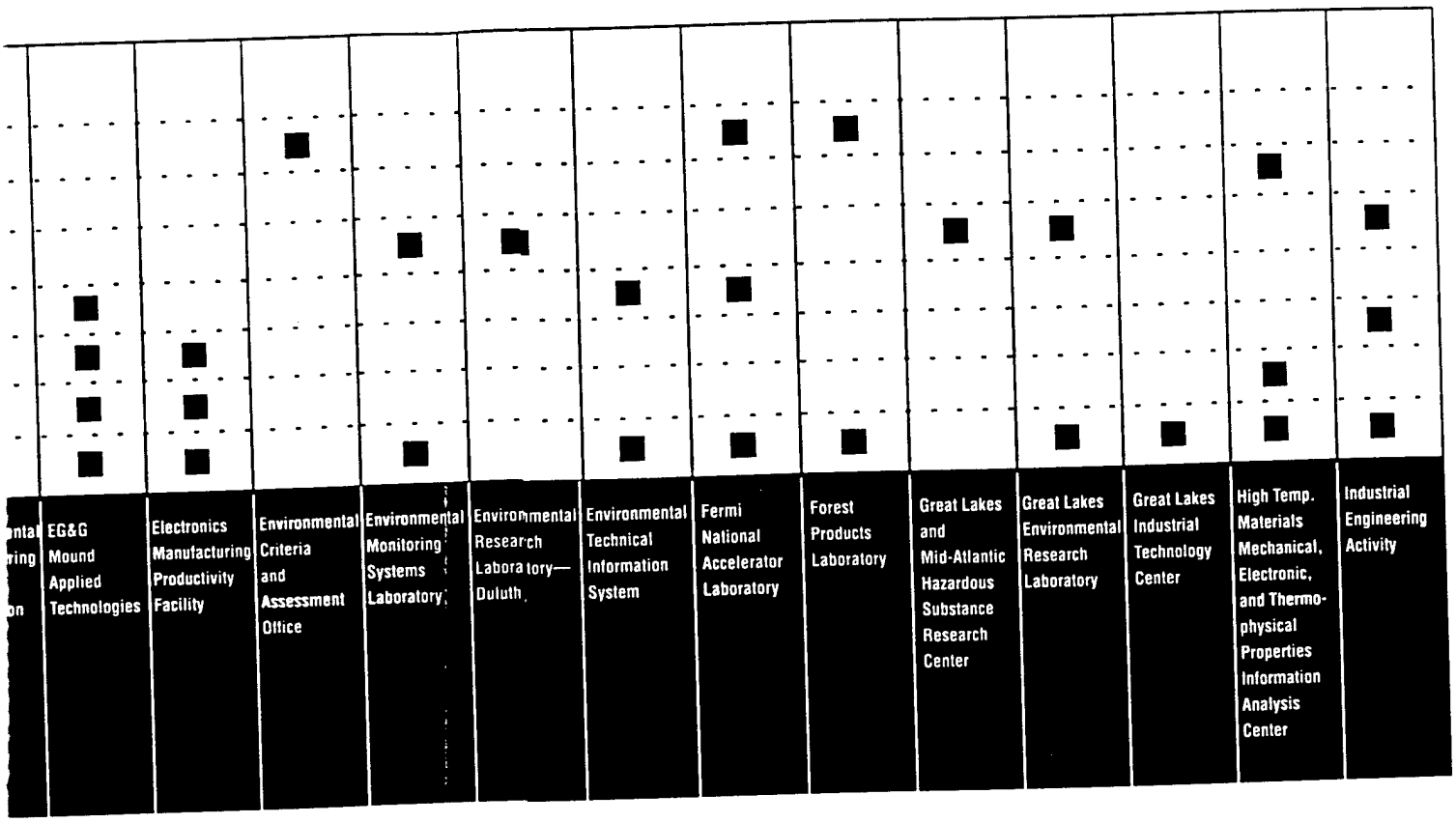

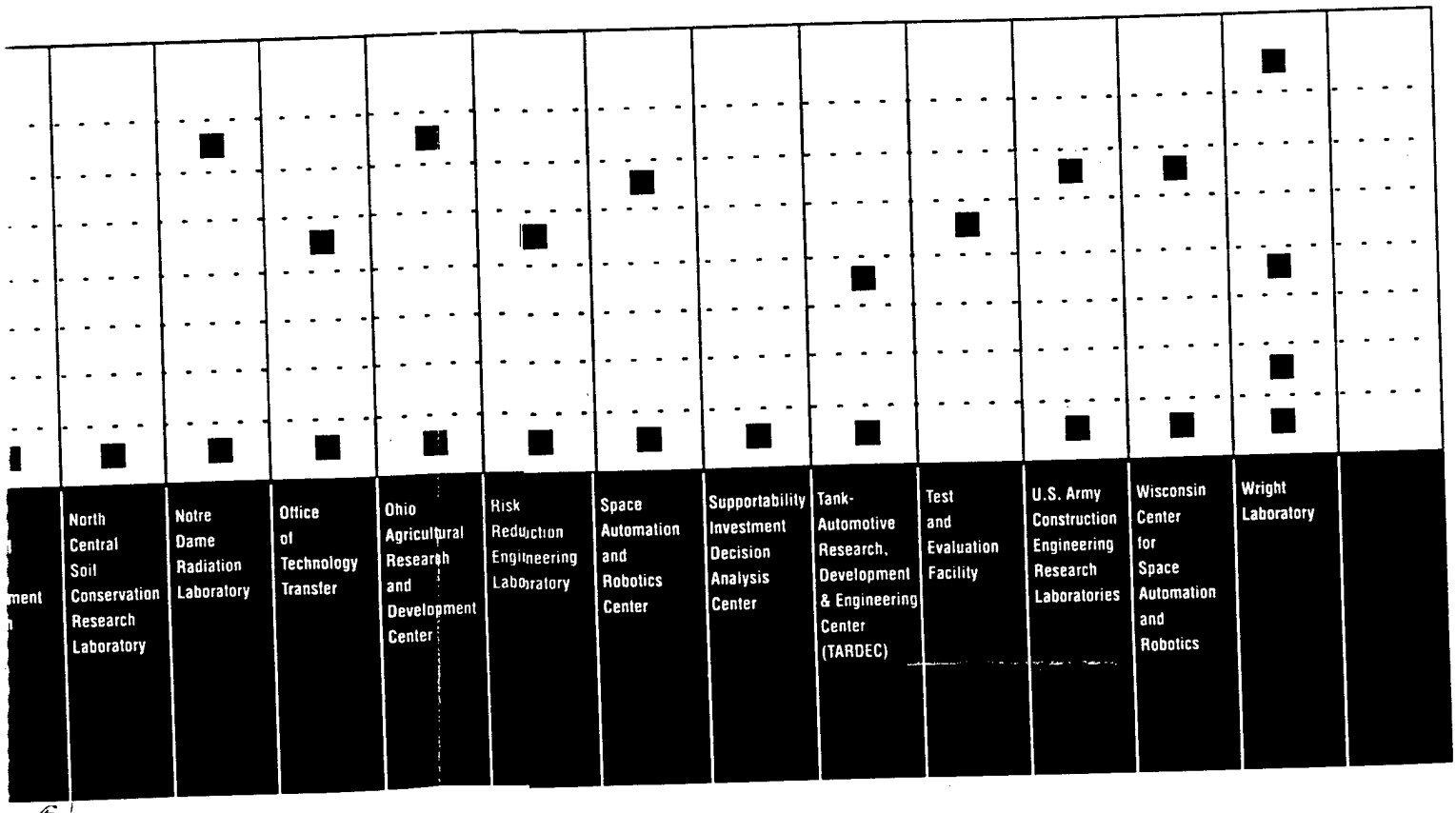

Aeronautics

Center for Commercial Development of Space on Materials for Space Structures – aeronautics and aerodynamics

Developmental Manufacturing and Modification Facility– aeronautics and aerodynamics

Lewis Research Center– advanced batteries, aeronautics and aerodynamics, propulsion technology

Wright Laboratory– advanced batteries, aeronautics and aerodynamics, propulsion technology

Biotechnology and Life Sciences

Argonne National Laboratory– applied molecular biology, applied molecular biology, biological processes,

Armstrong Lab– workplace safety

Avian Disease and Oncology Lab– applied molecular biology

Bureau of Mines Research Centers - Twin Cities– workplace safety

Crew Systems Ergonomic Information Analysis Center– workplace safety

Environmental Criteria and Assessment Office– diagnostics

Fermi National Accelerator Laboratory– medical devices, medical technology

Forest Products Laboratory– applied molecular biology

MSU-DOE Plant Research Laboratory– applied molecular biology

National Center for Agricultural Utilization Research– applied molecular biology, applied molecular biology, biological processes,

National Fisheries Research Center-Great Lakes– biological processes

National Fisheries Research Center-La Crosse– biological processes

National Highway Traffic Safety Administration – diagnostics

National Institute for Occupational Safety and Health– diagnostics, workplace safety

National Soil Erosion Research Lab– applied molecular biology

National Wildlife Health Research Center– diagnostics

Notre Dame Radiation Laboratory– biological processes

Energy Technology

Argonne National Laboratory– alternative energy technologies

High Temperature Materials Mechanical, Electronic, and Thermophysical Properties– alternative energy technologies

Lewis Research Center– advanced batteries, alternative energy technologies, photovoltaics, photovoltaic energy storage systems

New Brunswick Laboratory– alternative energy technologies

U.S. Army Construction Engineering Research Labs– alternative energy technologies

Wisconsin Center for Space Automation and Robotics– alternative energy technologies

Environmental Technologies

Argonne National Laboratory– hazardous waste remediation

Armstrong Lab– hazardous waste remediation, waste management

Bureau of Mines Research Centers - Twin Cities– pollution prevention

Center for Bioengineering and Pollution Control– hazardous waste remediation

Environmental Monitoring Systems Laboratory– pollution prevention, waste management

Environmental Research Laboratory-Duluth– pollution prevention

Great Lakes Environmental Research Lab– hazardous waste remediation

Great Lakes and Mid-Atlantic Hazardous Substance Research Center– waste management

Industrial Engineering Activity– pollution prevention

National Fisheries Research Center-Great Lakes– pollution prevention

National Vehicle and Fuel Emissions Laboratory– pollution prevention

Office of Technology Transfer– hazardous waste remediation, pollution prevention, waste management

Risk Reduction Engineering Laboratory– pollution prevention

Test and Evaluation Facility– hazardous waste remediation, pollution prevention, waste management

Information and Communications

Argonne National Laboratory– software

Center for Compound Semiconductor Microelectronics– optoelectronics

Center for Mapping– high performance computing

EG&G Mound Applied Technologies– software

Environmental Technical Information System– software

Fermi National Accelerator Laboratory– software

Infrared Information Analysis Center– optoelectronics

Lewis Research Center – microelectronics

Manufacturing Technology Information Analysis Center– computer simulation and modeling

Naval Air Warfare Center, Aircraft Division, Indianapolis– computer simulation and modeling, high definition displays

Naval Surface Warfare Center, Crane Division– microelectronics

Tank-Automotive Research, Development and Engineering Center– high performance computing

Wright Laboratory– microelectronics, optoelectronics

Manufacturing

Center for Intelligent Manufacturing Systems– artificial intelligence, machine intelligence and robotics

Center for Interfacial Manufacturing– general

Center for Net Shape Manufacturing Developmental Manufacturing and Modification Facility– general

Center for Plasma-Aided Manufacturing– general

EG&G Mound Applied Technologies– computer integrated

Electronics Manufacturing Productivity Facility– general

Industrial Engineering Activity– computer integrated

Infrared Information Analysis Center– sensor technology

Lewis Research Center– sensor technology

Naval Air Warfare Center, Aircraft Division, Indianapolis– computer integrated, systems management technologies

Space Automation and Robotics Center– artificial intelligence, machine intelligence and robotics

Tank-Automotive Research, Development and Engineering Center– flexible

U.S. Army Construction Engineering Research Labs– systems management technologies

Wisconsin Center for Space Automation and Robotics– artificial intelligence, machine intelligence and robotics

Wright Laboratory– systems management technologies

Materials

Center for Commercial Development of Space on Materials for Space Structures— coatings, composites, high-performance metals and alloys, polymers

Center for Compound Semiconductor Microelectronics— electronic and photonic, synthesis and processing

Center for Interfacial Manufacturing— coatings, polymers, synthesis and processing

Center for Net Shape Manufacturing— synthesis and processing

Center for Plasma-Aided Manufacturing— ceramics, high-performance metals and alloys, polymers, synthesis and processing

Ceramic Information Analysis Center— ceramics, coatings

EG&G Mound Applied Technologies— ceramics, high-performance metals and alloys

Electronic Manufacturing Productivity Facility— electronic & photonic

High Temperature Materials Mechanical, Electronic & Thermophysical Properties Information Analysis Center— composites, high-performance metals and alloys

Lewis Research Center— ceramics, composites, high-performance metals and alloys, polymers

Manufacturing Technology Information Analysis Center— electronic and photonic, high-performance metals and alloys

Metal Matrix Composites Information Analysis Center— composites, high-performance metals and alloys

Metals Information Analysis Center— coatings, electronic and photonic, high-performancemetals and alloys, synthesis and processing

Wright Laboratory— electronic and photonic, high-performance metals and alloys, synthesis and processing

Miscellaneous

Air Force Technology Transition Office– communication

Argonne National Laboratory– physics

Avian Disease and Oncology Lab– agriculture and food

Center for Commercial Development of Space on Materials for Space Structures– industrial and mechanical engineering

Center for Interfacial Manufacturing–industrial and mechanical engineering

Center for Mapping– communication

Center for Net Shape Manufacturing– industrial and mechanical engineering

Center for Plasma-Aided Manufacturing– industrial and mechanical engineering

Ceramics Information Analysis Center– communication, industrial and mechanical engineering

Cereal Rust Lab– agriculture and food

Chicago Operations Office– communication

Crew System Ergonomic Information Analysis Center– communication

Dairy Forage Research Center– agriculture and food

EG&G Mound Technologies– combustion, engines and propulsion

Electronics Manufacturing Production Facility– education and training

Environmental Monitoring Systems Laboratory– agriculture and food

Environmental Technical Information System– communication

Fermi National Accelerator Laboratory– physics

Forest Products Lab– agriculture and food

Great Lakes Industrial Technology Center– communication

Great Lakes and Mid-Atlantic Hazardous Substance Research Center– education and training

High Temperature Materials Mechanical, Electronics, and Thermophysical Properties– industrial and mechanical engineering

Industrial Engineering Activity– industrial and mechanical engineering

Infrared Information Analysis Center– communication

Lewis Research Center– atmospheric sciences, combustion, engines and propulsion

Manufacturing Technology Information Analysis Center– communication

Metal Matrix Composites Information Analysis Center– industrial and mechanical engineering

Metals Information Analysis Center– communication, industrial and mechanical engineering

MSU-DOE Plant Research Laboratory– communication

National Arboretum Research Unit– agriculture and food

National Center for Agricultural Utilization Research Lab– agriculture and food

National Fisheries Research Center - La Crosse– communication

National Highway Traffic Safety Administration– communication

National Soil Erosion Research Lab– agriculture and food

North Central Forest Experiment Station– agriculture and food, communication

North Central Soil Conservation Research Lab– agriculture and food

Notre Dame Radiation Laboratory– physics

Office of Technology Transfer– communication

Ohio Agricultural Research and Development Center– agriculture and food

Risk Reduction Engineering Laboratory– industrial and me chanical engineering

Supportability Investment Decision Analysis Center– communication

Tank-Automotive Research, Development and Engineering Center– combustion, engines and propulsion, education and training

U.S. Army Construction Engineering Research Labs– industrial and mechanical engineering

Wisconsin Center for Space Automation and Robotics– agriculture and food

Wright Laboratory– industrial and mechanical engineering

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Department of Agriculture

Avian Disease and Oncology Laboratory

Avian Disease and Oncology Laboratory
Agricultural Research Services
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East Lansing, MI 48823
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Lab Description

The mission of the Avian Disease and Oncology Laboratory (ADOL) is to generate and disseminate information and provide effective leadership to solve current and future problems in neoplastic and certain other viral diseases of poultry. This is accomplished through the use of new technologies, the generation of new approaches, the implementation of an integrated multidisciplinary team approach, the maintenance and enhancement of expertise, the determination of client needs, and the establishment of long range, high risk research programs.

Individual Lab Descriptions

The ADOL, previously known as the Regional Poultry Research Laboratory, was originally established to study avian leukosis, a group of cancer-like diseases that are one of the most important causes of mortality in chickens. Two important diseases of this group that have been studied extensively by laboratory scientists are Marek's disease, caused by a herpesvirus, and lymphoid leukosis, caused by a retro-virus. These diseases are less prevalent now because of accomplishments by laboratory scientists leading to vaccines for Marek's disease and the partial eradication of lymphoid leukosis. These diseases, however, still cause mortality, reduced egg production, and broiler condemnation.

Scientists at ADOL are conducting research to further reduce losses from these and other viral diseases to chickens and turkeys to make poultry food products cheaper and of higher quality for consumers.

Unique Equipment, Facilities or Services

Established by the Agricultural Research Service of the U.S. Department of Agriculture in 1938, the laboratory supports and complements the efforts of federal, state and industry scientists throughout the United States. Located on a 50-acre tract bordered by Michigan State University, the laboratory houses about 45 full-time employees, including 9 senior scientists. The site permits close cooperation among personnel of the laboratory, the Michigan State Agricultural Experiment Station, and the teaching, research and extension facilities of Michigan State University. Disciplines represented by the laboratory scientists include genetics, virology, immunology, pathology, epidemiology, and molecular biology.

Research programs at ADOL are conducted in laboratory facilities, equipped with state-of-the-art instrumentation. Within the 15,000-square foot main laboratory building are individual research units equipped for the conduct of molecular biology, tissue culture, and other procedures. The laboratory has a library, and maintains specialized collections of viruses, cell lines and other biological materials.

Laboratory grounds include 24 additional buildings, mostly for housing breeding and experimental chickens. Many of these are containment buildings which have been renovated and equipped with filtered-air positive pressure systems or isolation cages to prevent unwanted spread of infection to housed chickens or to the environment. High-security isolators, recently modified so all waste products are sterilized by heat or filtration, are used to contain high-

risk pathogens and organisms modified by recombinant DNA technology.

Through extensive inbreeding of chickens for more than 40 years, laboratory scientists have developed lines with special characteristics of value to research programs in neoplastic diseases. Thirteen lines and sublines with a variety of defined characteristics are maintained for in-house and collaborative research. Included are those that resist or are susceptible to infection and tumor induction by Marek's disease, avian leukosis, or Rous sarcoma viruses. Other lines have varying degrees of histocompatibility, different alleles at the major histocompatibility complex, or different endogenous retroviral gene expression. These chickens are maintained in a quarantined state and, on the basis of frequent serologic tests, are considered to be free of infection with most of the common poultry pathogens. These specialized lines constitute a unique resource, not duplicated elsewhere in the world, for the laboratory's research program and for the scientific community.

ADOL conducts team-oriented, multidisciplinary research on five major programs: Marek's disease, avian retroviruses, genes for disease resistance, chicken genome map, and recombinant DNA vaccines.

Marek's Disease

Ongoing research focuses on characterization of virus strains and development of better vaccines using conventional and recombinant DNA technology; the study of Marek's disease virus latency; molecular studies on cellular and humoral immune mechanisms; and identification of viral genes involved in immunity and transformation, all of which will lead to an understanding of viral oncogenesis and the development of improved vaccines for optimal disease control.

The primary research focus is on avian leukosis virus, the cause of lymphoid leukosis, since it causes significant losses due to neoplasms and production problems in adult chickens. The research is aimed at identifying host, viral, and environmental factors that influence the response of chickens to infection with avian leukosis virus and at assisting commercial breeders in eradication programs. Eradication is a preferred control method. Research is also directed at developing biological and molecular methods for the diagnosis and classification of avian leukosis and reticulo-endotheliosis viruses and the tumor they induce.

Genes for Disease Resistance

Scientists are developing methods for improving the resistance of chickens by the identification and manipulation of host genes. Strategies for inserting avian retroviruses into the germ line are under development. In addition, genes regulating endogenous leukosis viruses, and immune response, especially those associated with the major histocompatibility complex (B-blood group), are being identified through conventional and molecular approaches so that breeders will have new tools for selecting for increased genetic resistance to disease.

Chicken Genome Map

A new program to identify chicken genes on the chromosomes and to construct a map of their location in the genome has been initiated. This map may be used to identify genes that influence disease resistance and other commercially important traits. Recombinant DNA techniques have identified more that 200 chicken structural and regulatory genes. As more genes are found, a map of equally spaced anchor markers will be identified along the chromosomes. A reference population of DNA has been developed from offspring of backcross matings of red junglefowl and highly inbred White Leghorn chickens to identify the anchor markers on the chromosomes. Morphological traits and genetic profiles will be maintained in a central database. The ADOL will provide hybridization probes and DNA to poultry breeders and geneticists for the identification of genes linked to economically important traits.

Recombinant DNA Vaccines

Recombinant DNA technology is being used to develop a new class of vaccines for common poultry diseases. Scientists are developing vector systems based on avian herpes and pox viruses in creating recombinant vaccine viruses with foreign genes coding for immunogenic proteins of important poultry pathogens. It is expected that animals immunized with the recombinant virus will be protected against challenge infections with the corresponding infectious agent. Recombinant DNA vaccines may find application in the control of Marek's disease, lymphoid leukosis, infectious bursal disease, hemorrhagic enteri-tis, and other diseases. These vaccines have many potential advantages compared to conventional products including greater safety, improved efficiency of production, and greater efficacy, especially in the presence of maternal immunity.

Unique Personnel Expertise

Ms. Ann Whitehead
ARS Patent Advisor
Beltsville, MD
(301) 504-6786

Patents for License

Contact Ms. Whitehead, (301) 504-6786

CRADAs

Monoclonal antibodies for diagnosis of Marek's disease
Vineland Laboratories, Vineland, New Jersey
1/1/91-9/30/95

Chicken MHC typing using DNA amplification and oligonucleotide probes
Gentra Systems, Inc., Minneapolis, Minnesota
5/1/92-4/30/95

Monoclonal antibodies for diagnosis of Marek's disease
Select Laboratories, Inc., Gainesville, Georgia
10/1/90-9/30/94

Construction of avian recombinant vaccine by inserting genes from avian viruses into fowlpox virus
Nippon Zeon Company, LTD., Tokyo, Japan
2/1/90-1/30/94

Monoclonal antibodies for diagnosis of Marek's disease
Intervet, Inc., Millsboro, Delaware
2/1/90-9/30/93

Monoclonal antibodies for diagnosis of Marek's disease
Solvay Animal Health, Inc., Mendota Heights, Minnesota
3/1/90-9/30/93

Interaction of serotype 2 and 3 vaccines for Marek's disease
Select Laboratories, Inc., Gainesville, Georgia
8/8/88-8/8/93

ADOL encourages collaboration with businesses in any of the following areas:

- Development of avian herpesvirus vector systems for production of poultry vaccines.
- Development of gene related recombinant vaccines for Marek's disease in chickens.
- Development of transgenic chickens resistant to Marek's disease.
- Development of peptide vaccines matched to the major histocompatibility locus for control of poultry diseases.
- Development of diagnostic kits for avian tumors and tumor viruses.

Department of Agriculture

Cereal Rust Laboratory

Lab Description

The mission of the Cereal Rust Laboratory (CRL) is to investigate the stem and leaf rusts of small grains and to develop information and principles useful in the control of these diseases.

Cereal Rust Laboratory
Agricultural Research Services
University of Minnesota
1551 Lindig Street
St. Paul, MN 55108
Dr. Kurt Leonard
Phone: (612) 625-6299
FAX: (612) 649-5054

Individual Lab Descriptions

The CRL conducts research programs including the following:

Resistance—identification of race-specific resistance as well as other potentially valuable types of resistance;
Epidemiology—analysis of regional and local spread of rust diseases in relation to weather, cropping patterns, and biology of the rust fungi, and determination of economic losses caused by cereal rusts;
Population genetics—evaluation of genetic diversity in rust fungus populations in relation to shifting virulence patterns as the rust fungi respond to changes in cereal cultivars;
Physiology—identifying the basic mechanisms underlying fungal development, their nutritional relationships with the cereal host, and the nature of the host response to infection;
Molecular genetics—molecular analysis of genes that control virulence or are important in development and evolution in rust fungi.

Unique Equipment, Facilities or Services

The Cereal Rust Laboratory performs a number of services that are essential to maintaining control of stem and leaf rusts of cereals. These include the following:

- Survey the important small grain producing regions of the United States for stem and leaf rust severity and assess yield losses to these rusts.
- Prepare the Cereal Rust Bulletin, which summarizes the status of cereal rust diseases in the United States periodically during the crop season. The bulletin is distributed to approximately 600 subscribers.
- Collect information on yield losses from rusts in small grains from cooperating observers in each state at the end of the crop season. Prepare a loss summary and distribute it to all interested parties.
- Collect rust samples from small grains, wild grasses, and alternate hosts throughout the important small grain producing regions of the United States.
- Determine the frequencies of pathogenic races present.
- Identify races of samples submitted by numerous cooperators in plant protection and plant breeding programs throughout the United States.

Unique Personnel Expertise

Scientists at the Cereal Rust Laboratory cooperate closely with colleagues in the Department of Plant Pathology at the University of Minnesota. They also work closely with other organizations concerned with quality and production of small grains. As the national center for research on rust diseases of small grains, the Cereal Rust Laboratory has important contacts with cereal scientists throughout the world as well as within the United States.

Department of Agriculture

Dairy Forage Research Center

Lab Description

The overall objective of the Center is to increase efficiency of forage production and utilization in the dairy industry. This objective can be met by providing the dairy industry with appropriate scientific and technological knowledge to more fully use the large forage potentials of the U. S.

Dairy Forage Research Center
Agricultural Research Services
1925 Linden Drive West
Madison, WI 53706
Dr. Larry D. Satter
Phone: (608) 263-2030
FAX: (608) 264-5275
FTS: 364-5240

The mission of the U. S. Dairy Forage Research Center (USDFRC) is to address problems that are national in scope which limit effective and efficient use of forage for the production of milk. The Center provides leadership in coordinating multidiscipli-nary research involving engineers, microbiologists, chemists, and plant and animal scientists at locations in five states. The research is directed toward increasing yields and quality of forage grown and harvested, reducing losses associated with harvesting, storage and feeding, and maximizing use of forage nutrients by the dairy cow for milk production.

Individual Lab Descriptions

Present and future research by Center scientists in the following six problem areas illustrates the research being emphasized to enable achievement of the USDFRC mission.

Research Focuses On:

- Forage production.
- Forage quality and chemical composition.
- Forage harvest and storage.
- Forage preservation.
- Rumen microbiology.
- Forage utilization by cattle and sheep.
- Research procedures.

Unique Equipment, Facilities or Services

The United States Dairy Forage Research Center contains a field facility which provides barns to house a research herd of 300 milking cows plus 250 replacement heifers and 1400 acres of land for agronomic research and feed production.

A laboratory facility, fully equipped with typical instrumentation, including GC mass spectrometry and NMR, houses ten scientists plus associated employees. The laboratory facility includes an engineering complex fully equipped for construction of experimental farm equipment.

Patents for License

Process (and Prototype Machine) to Improve the Properties and Value of Forage Crops
Richard Koegel, Timothy Kraus—U.S. Dairy Forage Research Center; Kevin Shinners, Richard Straub — Agr. Engr. Dept., Univ. of WI-Madison
Patent No. 5,152,127

CRADAs

Silage Additives to Reduce Aerobic Deterioration
Richard E. Muck, USDFRC and Nutrena Feed Division, Cargill, Inc.

Department of Agriculture

Forest Products Laboratory

Lab Description

The guiding principle of the Forest Products Laboratory is to improve the use of wood through science and technology, thereby contributing to the conservation and management of the forest resource.

Forest Products Laboratory
Agricultural Research Services
One Gifford Pinchot Drive
Madison, Wisconsin 53705-2398
Mr. John Zerbe
Phone: (608) 231-9353
FAX: (608) 231-9592

Organizational Structure

The Forest Products Laboratory, located within the Forest Service, is divided into five areas of research: International Forest Products, Protection and Market Research, Wood Products Research, Institute for Microbial and Biochemical Technology, and Pulp, Paper and Composites Research. The laboratory also contains a Forest Products Conservation and Recycling Technology Marketing Unit.

Individual Lab Descriptions

The FPL conducts research to expand the understanding of all aspects of conversion and use of the timber resource. Research programs are accomplished through coordinated partnerships involving industry, university, and government. The FPL conducts research and technology transfer in five broad areas: wood products, pulp, paper and composites, protection and market, microbial and biochemical conversion, and international forest products.

Unique Equipment, Facilities or Services

Professional and technical specialists staff several testing facilities, including an analytical laboratory, an engineering mechanics laboratory, a fire testing laboratory, and a pulp and paper pilot plant.

Publishing research findings to meet the needs of many users, such as the general public, industry (many sectors), regulatory agencies, state and private foresters, private landowners, educators, and other government agencies and legislative bodies. The FPL has published thousands of technical reports and several major USDA handbooks. More than 100 scholarly journals have published FPL research results. In addition, the laboratory hosts hundreds of consulting visitors each year.

Unique Personnel Expertise

Approximately 350 people are employed by the FPL, including approximately 100 research scientists and scientific professionals, such as botanists, chemists, plant pathologists, engineers, biologists, physicists, economists, foresters, and microbiologists, investigating ways to improve conversion and use of wood and paper products.

Patents for License

Radio controlled skyline logging carriage and system
Cleveland J. Biller
Patent No. 4,735,327
4/5/88

Apparatus for forming uniform density structral fiberboard
Dennis E. Gunderson
Patent No. 4,753,713
6/28/88

Mechanism for storing singulating and planting woody cuttings
Roy J. Kangas
Patent No. 4,732,094
3/22/88

Method for producing salts of monoperosysluafuric acid and simultaneously bleaching pulp
Edward L. Springer
Patent No. 4,756,800
7/12/88

Method and apparatus for nondestructively determining the density.
Jerrold E. Winandy
Patent No. 4,747,308
5/31/88

Acetylation of lignocellulosic materials
Roger M. Rowell
Patent No. 4,804,384
2/14/89

Multiple bandmill for making a plurality of sawlines.
Jeanne D. Danielson
Patent No. 4,864,905
9/12/89

Self-feeding wood chunker
Rodger A. Arola
Patent No. 4,972,889
11/27/90

Method and apparatus for testing material using strain and moisture sorption
Dennis E. Gunderson
Patent No. 4,934,181
6/19/90

Device for regulating lumious flux of battery powered headlamp
David S. Gasvoda
Patent No. 4,949,014
8/14/90

Delignification of lignocellulosic materials with monoperoxysulfuric acid
Edward L. Springer
Patent No. 5,004,523
4/2/91

Douglas-fir tree "Tourquis" Variety
Stephen P. Wells
Plant 7,553
6/11/91

Biomechanical pulping with C. subvermispora
Robert Blanchete, Gary Leatham, Michael Attridge, Masood Akhtar, Gary Myers
Patent No. 5,055,159
10/8/92

Xylose-fermenting yeast mutants
Thomas Jeffries, Philip Livingston
Patent No. 5,126,266
6/30/92

Apparatus for forming structural components from dry wood fiber furnish
Dennis Gunderson, Roland Gleisner
Patent No. 5,198,236
3/30/93

Method for fiber loading a chemical compound
John Klungness, Daniel Caulfield, Irving Sachs, Marguerite Sykes, Freya Tan, Richard Shilts
Patent No. 5,223,090
6/29/93

One step process for imparting decay resistance and fire retardancy to wood products
Susan LeVan, Rodney De Groot
Patent No. 5,185,214
2/9/93

Department of Agriculture

National Arboretum Research Unit

Lab Description

The Research Unit of the U.S. National Arboretum is dedicated to providing the public with new and superior woody plants that will enhance the evironment and reduce the use of potentially toxic pesticides. This mission embraces both basic and applied research dealing with the acquisition and testing of domestic and foreign germ-plasm, the determination of the proper taxonomic classification and nomenclature of plant materials, interspecific and intraspecific hybridization, and the development of short- and long-term screening methods for pest resistance and tolerance of environmental stresses.

USNA - Ohio Research Site
359 Main Road
Delaware, OH 43015
Dr. Lawrence Schrieber
Phone: (614) 363-1129
Fax: (614) 363-1120

The Research Unit conducts research in the following areas:

- Testing of domestic and foreign germplasm
- Determination of proper nomenclature of plant materials
- Interspecific and intraspecific hybridization
- Short and long term screening methods for pest resistance and tolerance of environmental stresses.

Department of Agriculture

National Center for Agricultural Utilization Research

Lab Description

The National Center for Agricultural Utilization Research (NCAUR) is a laboratory of the Agricultural Research Service, U.S. Department of Agriculture. As the in-house research arm of the USDA, the Agricultural Research Service mission is to develop new knowledge and technology needed to solve technical and agricultural problems of broad scope and high national priority in order to ensure adequate production of high-quality food and agricultural products to meet the nutritional needs of the American consumer, to sustain a viable food and agricultural economy, and to maintain a quality environment and natural resource base.

The mission of NCAUR encompasses three areas that are interrelated: enhancing competitiveness of U.S. agriculture via involvement of new market opportunities, environmental quality and compatibility, and food safety. The overall goal is to develop and facilitate commercialization of products and uses from agricultural commodities. Expansion and diversification of the agricultural portfolio will strengthen U.S. competitiveness internationally, enhance exports and reduce imports. NCAUR is positioned to contribute toward achieving this goal by:

National Center for Agricultural Utilization Research
Agricultural Research Services
1815 North University Street
Peoria, IL 61604
Phone: (309) 685-4011
FAX: (309) 681-6686

- Developing environmentally safe, value-added industrial and food products, and uses from agricultural commodities and their byproducts;
- Exploiting natural biosynthetic systems and associated genes coding for useful products;
- Developing technology in conjunction with USDA Action and Regulatory Agencies and other organizations that will enhance competitiveness of U.S. agricultural products.

NCAUR continues the role of the Peoria Laboratory as the designated lead USDA Technology Transfer Facility to facilitate and accelerate commercialization of promising products and technology emanating from the Center's research and development program.

Individual Lab Descriptions

Bioscience

New methods for exploiting plants and botanical resources are becoming important as demands on agriculture grow and as the world looks for ways to reduce dependence on petroleum and coal. Molecular biology in basic research is used to gain a better overall understanding of microorganisms and plants and has led to the development of genes that may someday allow genetic engineering of their properties.

At NCAUR, tissue culture is used to investigate secondary plant products and cell metabolism. Plant tissue culture is a method of investigating plant metabolism, development and growth without the constraints of whole plants. Generally, it is the random growth of cells or the specific manipulation of special cells to regenerate plants.

In addition, NCAUR's research interests include working with microorganisms with unusual biochemical abilities or using ones that have been genetically altered by introduction of specific genes. These microorganisms will be used to develop new ways to utilize raw agricultural materials (corn starch, forages, soybean oil); create

commercially useful products from agricultural wastes (hulls, fibers, distiller grains); or produce materials containing microorganisms or microbial compounds for control of weeds or of plant diseases.

Food and Fiber Science

Starch and proteins are utilized in a wide variety of ways in foods and industrial products. Properties of these products depend not only on the molecular composition of the starch and protein components and their mixtures but also on mechanical and thermal forces encountered during processing. Determination and interpretation of physical properties, and particularly understanding the response of material to flow and deformational (rheological) forces, is vital for modifying and controlling these properties especially as they relate to processing conditions and end uses. One area of investigation deals with the effect of wheat variety on properties and procession of wheat flour doughs. Another problem area relates to the processing of starches. Starch is frequently dispersed in water in a variety of ways, including pasting at temperatures below 100C and jet cooking under extreme conditions of flow, temperature and pressure. Different treatments result in different properties for reasons which are complex and only partly understood. This research is designed to provide fundamental scientific and engineering data for improved quality control and process design. In addition, this area studies fats, lipids, triglycerides and hydrocarbons to determine their properties and how they contribute to foods and household goods.

Industrial Products Science

Research at NCAUR concerns the development of novel fermentation strategies that will result in the generation of new products from agricultural commodities (e.g. corn) or offer more efficient conversions that are currently employed commercially. Scientists are working to combine plant starch with synthetic petroleum-derived polymers to create new forms of polymers with different properties. Other research aims at converting plant oils into new chemicals by use of enzymes. In addition, scientists conduct fundamental studies on combustion chemistry using vegetable oils.

Crop Protection Science

NCAUR scientists study large quantities of starch encapsulated herbicides in field studies against commercial formulations to compare weed control and to show reduction in groundwater contamination. Scientists are also developing and studying pheromone-based insecticides for effectiveness. In other research, scientists are developing methods for controlling noxious weeds and insects by infecting them with naturally occurring fungal pathogens. The isolation, purification and indentification of natural plant growth regulators and the evaluation of these compounds for commercial use is also being investigated.

Science of Natural Toxins

The goal of NCAUR research is to determine possible means to control or prevent the contamination of foods and feeds with various mycotoxins. Mycotoxins are poisonous chemical compounds produced by fungi (molds) and they can occur as the result of growth of the fungi on grains or other foods and feeds. When contaminated foods or feeds are consumed by humans and other animals, a variety of diseases may result depending upon the specific mycotoxin ingested. These diseases may be acute, resulting in sudden death, or may be more prolonged, resulting in poor weight gains, suppression of immunity, or tumors.

Developing methods to control mycotoxins requires basic knowledge of the way in which fungi produce these toxic substances. The formation of mycotoxins by fungi is frequently the result of a long and complex process. NCAUR scientists determine many of the steps leading to the formation of Fusarium mycotoxins by studying fungi that have been genetically altered so that they no longer make mycotoxins. These fungal mutants can also be used to demonstrate that the production of mycotoxins plays a role in plant diseases caused by Fusarium.

Patents for License

Control of Pests with Annonaceous Acetogenis Tetrahydrofuranoid acetogenins
Kenneth L. Mikolajczak, Jerry L. McLaughlin and James J. Rupprecht
Patent No. 4,721,727

Separation of Cyclodextrins by Affinity Chromatography
Jacob A. Rendleman, Jr.
07/159,990

Process for Stabilizing Whole Cereal Grains
George N. Bookwalter
Patent No. 4,737,371

Modified Plant Fiber Additive for Food Formulations
John M. Gould and Lee B. Dexter
Patent No. 4,774,098

Alkaline Peroxide Treatment of Agricultural Byproducts
John M. Gould
Patent No. 4,806,475

Inhibition of Trichothecene Toxins by Ancymidol
Anne E. Desjardins
Patent No. 4,816,406

Moisture-Shrinkable Films from Starch Graft Copolymers
George F. Fanta and Felix H. Otey
Patent No. 4,839,450

Formulate Milk Concentrate and Beverage
George N. Bookwalter and Steven A. Lyle
Patent No. 4,842,884

Enzyme Immobilization with a Hydrolyzed Polysaccharide Graft Copolymer
George F. Fanta and Patricia J. Slininger
Patent No. 4,845,035

Adherent, Autoencapsulating Spray Formulations of Biocontrol Agents
Baruch S. Shasha and Michael R. McGuire
07/389,090

Control of Pests with Annonaceous Acetogenis Tetrahydrofuranoid Acetogenins
Kenneth L. Mikolajcak, Jerry L. McLaughlin and James K. Rupprecht
Patent No. 4,855,319

Starch Encapsulation of Entomopathogens
Baruch S. Shasha and Richard L. Dunkle
Patent No. 4,859,377

Separation of Cyclodextrins by Affinity Chromatography
Jacob A. Rendleman, Jr.
Patent No. 4,867,884

Fusarium sporotrichioides Mutant Strain Capable of Producing Both Dideacetylcalonectrin and Deacetylcalonectrin
Marian N. Beremand and Patricia J. Black
Patent No. 4,880,747

Heat-Stable, Salt-Tolerant Microbial Xanthanase
Martin C. Cadmus and Morey E. Slodki
Patent No. 4,886,746

Synthetic Gene for Acyl Carrier Protein
Phillip D. Beremand and John B. Ohlrogge
Patent No. 4,888,282

Acyl Carrier Protein-I/Protein-A Gene Fusion Products and Methods
P. D. Beremand and D. J. Guerra
07/494,004

Microbial Production of a Novel Compound, 7,10-Dihydroxy-8-octadecen-oic Acid from Oleic Acid
Ching T. Hou and Marvin O. Bagby
07/496,577

Encapsulating by Entrapment within Matrix of Unmodified Starch
William M. Doane, Sukumar Maiti and Robert E. Wing
Patent No. 4,911,952

Vegetable Oil-Based Printing Ink
Sevim Z. Erhan and Marvin O. Bagby
07/519,197

Supercritical Fluid Extraction Enhancer
M. L. Hopper and Jerry W. King
07/536,861

Starch Encapsulation of Biologically Active Agents by a Continuous Process
Merle E. Carr, William M. Doane, Robert E. Wing and Edward B. Bagley
07/542,566

Organic Nitriles as Insect Antifeedants
Richard G. Powell, Kenneth L. Mikolajcak, Bruce W. Zilkowski, Jon Clardy and Ellen K. Mantus
Patent No. 4,942,247

Whipping Topping Formulation
George N. Bookwalter
07/542,565

Microbial Detoxification of Jojoba Toxins
Thomas P. Abbott and Lawrence K. Nakamura
07/557,827

Control of Insects by Roseotoxin B
Patrick F. Dowd and Richard J. Cole
Patent No. 4,956,343

Kojic Acid and Esters as Insecticide Synergists
Patrick F. Dowd
Patent No. 4,956,353

Production of 3-Hydroxypropionaldehyde from Glycero by Klebsiella Pneumoniae
Patricia J. Slininger, James E. Van Cauwenberge and Rodney J. Bothast
Patent No. 4,962,027

Microbial Production of L-Altrose
Robert J. Stack
Patent No. 4,966,845

Organic Nitriles as Insect Antifeedants
Richard G. Powell, Kenneth L. Milkolajczak, Bruce W. Zilkowski,
Jon Clardy and Ellen K. Mantus
Patent No. 4,966,913

Biologically Pure Culture of Yeast Strain Used for the Microbial Detoxification of Xenobiotics
Patrick F. Dowd and Samuel K. Shen
Patent No. 4,968,620

Organophosphorus Insecticides as Synergicides for Carpophilus spp. Pheromones
Patrick F. Dowd and Robert J. Bartelt
07/610,903

Cellylolytic, N2-Fixing Bacteria and Use Thereof
Lee B. Dexter and John M. Gould
Patent No. 4,973,559

Control of Insects by Fungal Tremorgenic Mycotoxins
Partick F. Dowd, Richard J. Cole and Ronald F. Vesonder
Patent No. 4,973,601

Inhibition of Potato Sprouting Using Volitle
Steven F. Vaughn, Gayland F. Spencer and Richard G. Powell
07/634,853

Method for Producting Trichothecenes and Related Materials
Marican N. Beremand and Particia J. Black
Patent No. 4,994,383

A Method for Making a soluble Dietary Fiber Composition from Oats
George E. Inglett
Patent No. 4,996,063

Heat-Stable, Salt-Tolerant Microbial Xanthanase and Method of Producing Same
Martin C. Cadmus and Morey E. Slodki
Patent No. 4,996,153

Production of Hydroxy Fatty Acids and Estolide Intermediates
Douglas A. Burg and Robert Kleiman
07/662,606

Combined Physical and Chemical Treatment to Improve Lignocellulose Digestibility
John M. Gould and Brian K. Jasberg
Patent No. 4,997,488

Vectors for Gene Insertion Into Avian Germ Life
S. H. Hughes and D. W. Salter
Patent No. 4,997,763

Aggregation Phyeromones of the Nitidulid Beetles Carpophilus hemipterus, Carpophilus lugubris and Carpophilus freemani
Robert J. Bartelt and Patrick F. Dowd
Patent No. 5,008,478

Wind-Oriented Funnel Trap
Patrick F. Dowd, Robet J. Bartelt and Donald T. Wicklow
07/694,534

Nominine, An Insecticidal Fungal Metabolite
Patrick F. Dowd, Donald T. Wicklow, James B. Gloer, and Brad L. Rinderkneckt
Patent No. 5,017,598

Aggregation Pheromones of the Driedfruit Beetle, Carpo-pilus hemipterus
Robert J. Bartelt and Patrick F. Dowd
Patent No. 5,011,683

Method for Producing Trichothecenes
Marian N. Beremand, Frank L. Van Middlesworth, and Ronald D. Plattner
Patent No. 5,021,343

Adherent, Autoencapsulating Spray Formulations of Biocontrol Agents
Baruch S. Shasha and Michael R. McGuire
Patent No. 5,061,697

Wind-Oriented Funnel Trap
Patrick F. Dowd, Robert J. Bartelt and Donald T. Wicklow
Patent No. 5,081,788

Method of Making Soluble Dietary Fiber Compositions from Cereals
George E. Inglett
Patent No. 5,082,673

Vegetable Oil-Based Ink
Sevim Z. Erhan and Marvin O. Bagby
Patent No. 5,122,188

Aromatic Compounds as Potato Tuber Sprout Inhibitors
Steven F. Vaughn and Gaylan F. Spencer
Patent No. 5,129,951

Inhibition of Potato Sprouting Using Volatile Monoterpenes
Steven F. Vaughn, Gayland F. Spencer and Richard G. Powell
Patent No. 5,139,562

These patents are assigned to the Secretary of Agriculture. Copies of patents may be purchased from the Commissioner of Patents and Trademarks, U.S. Patent and Trademark Office, Washington, D.C. 20231. Order by number. Do not send stamps.

Department of Agriculture

National Soil Erosion Research Laboratory

Lab Description

The mission of the National Soil Erosion Research Laboratory (NSERL) is to develop the knowledge and technology for land users to conserve soil for future generations.

Organizational Structure

The NSERL is under the jurisdiction of the Agricultural Research Service, an agency of the U.S. Department of Agriculture.

National Soil Erosion Research Laboratory
1196 Soil Building
West Lafayette, IN 47907-1196
Mr. John M. Laflen
Phone: (317) 494-8673
FAX: (317) 494-5948

Individual Lab Descriptions

To fulfill the laboratory's mission, the NSERL conducts a program of applied and fundamental research and technology development, particularly in the areas of soil erosion control and soil erosion prediction.

Department of Agriculture

North Central Forest Experiment Station

Lab Description

The mission of the North Central Forest Experiment Station (NCFES) is to create, evaluate and disseminate information and technology to improve management and use of our natural resources.

North Central Forest Experiment Station
Agricultural Research Services
1992 Folwell Avenue
St. Paul, MN 55108
Mr. Dave Lothner
Phone: (612) 649-5249
FAX: (612) 649-5285

Individual Lab Descriptions

NCFES' research is conducted in the following areas:

- Mathematical Models of Forest Dynamics for the North Central Region.
- Integrated approaches to wildlife and fish management.
- Rapid Systems for disease resistance and control of diseases in nurseries, forests, plantations and Christmas Tree plantings.
- Forest inventory and analysis.
- Social and economic decisions of ecosystem management.
- Physiology, genetics and processing of the central hardwoods.
- Managing urban and high use recreational settings.
- Silviculture and ecology of the upland central hardwood forests.
- Atmospheric and socioeconomic relationships with wildland fire.
- Stress effects on tree - insect - natural enemy interactions.
- Economics of alternate forest management choices in the north.
- Silviculture in the northern lake states.
- Water quality management in forests of the western Great Lakes region.
- Engineering technology for managing northern forest stands.
- Site productivity of cental hardwood forest ecosystems.
- Long-term strategies and techniques in forest genetics.
- Physiological mechanisms of growth and multiple stress responses in northern forest trees.
- Principles of landscape ecology for managing temperate forests.
- Genetic and molecular bases of tree stress tolerances.

Patents for License

Involuted Disc Slicer
#4,431,039

Department of Agriculture

North Central Soil Conservation Research Laboratory

Lab Description

The mission of the North Central Soil Conservation Laboratory (NCSCRL) at Morris, Minnesota is to develop cost effective and sustainable conservation production systems for northern climates that do not degrade surface or ground water quality. Northern climates correspond physio-graphically to the Corn Belt Region, or soils that are annually subjected to at least one freeze-thaw cycle in the surface 20cm. Characteristics of northern climates resulting in production-related problems are climatic extremes, especially with respect to temperature, and intense but often limiting precipitation; soil diversity with respect to age, inherent fertility, water holding capacity and erodibility; and complex interactions between plant-soil-climate that often result in yield reducing plant stress. The research conducted includes soil, plant, and erosion factors. Processes considering these factors are integrated into a dynamic conservation production system model to evaluate production-limiting variables. This research addresses long-term scientific stewardship, and provides basic information for national high priority problem solving, and transfers technology directly to user groups.

North Central Soil Conservation Research Laboratory
North Iowa Avenue
Morris, MN 56267
Mr. Ward B. Voorhees
Phone: (612) 589-3411
FAX: (612) 589-3787

Individual Lab Descriptions

NCSCRL conducts field and laboratory research on soil erosion, surface and ground water quality, tillage, soil compaction, soil freezing, residue management, nutrient uptake, water use efficiency, photosynthesis, mechanical and chemical weed control, and farming systems.

Department of Agriculture

Ohio Agricultural Research and Development Center

Lab Description

The Ohio Agricultural Research and Development Center (OARDC) is one of the premier agricultural experiment stations in the nation. OARDC scientists conduct basic and applied research in agriculture, natural resources, human ecology and related fields. This research deals with the interrelationship of all agricultural production and marketing practices. It is concerned with the development of an agricultural product from the germination of a seed or development of an embryo through to the consumer's dinner table. It is directed at improved human nutrition, family and child development, home management, and all aspects of family life. It is geared to enhancing and preserving the quality of our environment.

About 400 research projects are conducted by scientists in 14 departments and program areas: Agricultural Economics and Rural Sociology; Agricultural Education; Agricultural Engineering Agronomy; Animal Science; Dairy Science; Entomology; Food Animal Health; Food Science and Technology; Horticulture; Plant Pathology; Poultry Science; the School of Natural Resources; and the College of Human Ecology. Research in each of these fields are listed below.

The Ohio Agricultural Research and Development Center
209 Research Services Building
1680 Madison Ave.
Wooster, OH 44691
Dr. Thomas Payne, Director—OARDC
Phone: (614) 292-3897

Office of Technology Transfer
The Ohio State University
1960 Kenny Road
Columbus, OH 43210-1063
Ms. Robin Rasor, Assistant Director, Technology Transfer
Phone: (614) 292-3911
FAX: (614) 292-1727

- Agronomy
  - crop genetics and breeding
  - plant molecular biology and tissue culture
  - crop physiology
  - crop management and production
  - weed science
  - turf science
  - soil physics
  - soil fertility
  - soil chemistry
  - soil classification and mineralogy
  - soil microbiology and biochemistry
- Food Animal Health Research Program
  - infectious diseases
  - disease prevention and immunity
  - development of diagnostic methods
  - microbiology
  - biotechnology
  - pathology
  - parasitology
  - herd health management
- Plant Pathology
  - biology and control of soil-borne plant pathogens
  - ecology, epidemiology and integrated control of plant pathogens
  - maize virology
  - molecular biology of host parasite interactions
  - plant disease diagnostics (diagnostic biotechnology)
- Agricultural Engineering
  - natural resources and environment
  - food and process engineering
  - machinery systems engineering

- alternative energy systems
- controlled environment plant and animal systems

- Horticulture
  - genetics and plant breeding
  - soils and plant nutrition
  - plant physiology
  - biotechnology
  - post-harvest physiology
  - herbicide chemistry and physiology
  - economics and marketing
  - plant/soil water relations
  - controlled environment physiology
  - seed physiology
  - plant product quality
  - host plant resistance to insects
- Natural Resources
  - aquaculture
  - atmospheric deposition
  - Christmas tree production
  - conflict resolution
  - ecotechnology
  - environmental education
  - fisheries management
  - forest ecology and biology
  - forest pathology
  - forest ecosystem restoration
  - forest genetics
  - forest tree improvement
  - mined-land reclamation
  - park management
  - remote sensing
  - wetland ecology and management
  - watershed policy and management
  - wildlife management
- Poultry Science
  - biotechnology
  - food safety
  - animal breeding
  - growth physiology
  - turkey management
  - nutrition
  - reproduction
  - poultry health
- Human Ecology
  - nutrition and health
  - youth and families at risk
  - work and family
  - family/consumer decision-making and resource management
- Agricultural Education
  - learning styles
  - technology in agricultural communication
  - rural community education
  - adult education
  - youth at risk
  - needs assessment and policy analysis
  - leadership supervision
- Agricultural Economics and Rural Sociology
  - competitiveness and profitability
  - marketing efficiency and structure
  - policy, trade and outlook
  - rural finance
  - resource and environment development
  - social change and development
- Food Science and Technology
  - food safety
  - nutritional biochemistry
  - food biotechnology
  - food microbiology
  - food chemistry
  - food process engineering
  - sensory properties and physical stability of food
- Dairy Science
  - biotechnology
  - food, feed, and animal safety
  - genetics
  - mammary physiology
  - management
  - mastitis and health
  - nutrition
  - reproduction
- Entomology
  - arthopod vectors
  - biological control
  - chemical ecology
  - host plant resistance
  - insect biology
  - insecticide degradation
  - integrated pest management
  - microbial insecticides
  - pesticide application technology
- Animal Science
  - nutrition
  - reproduction
  - breeding and genetics
  - metabolism
  - microbiology
  - meat
  - forage utilization
  - management

Organizational Structure

The Ohio State University Board of Trustees governs OARDC. Chairs and associate chairs of the 14 subject matter departments and program areas have administrative responsibilities for OARDC-supported research in the Colleges of Agriculture, Biological Sciences, Human Ecology, and Veterinary Medicine.

Patents for License

Patents and CRADAs are available through the OARDC and through The Ohio State University. Contact Robin Rasor, Associate Director of Technology Transfer, at (614) 292-3911 for more information.

Department of Commerce

Great Lakes Environmental Research Laboratory

Lab Description

The Great Lakes Environmental Research Laboratory's (GLERL) mission is to conduct integrated interdisciplinary environmental research in support of resource management and environmental services in coastal and estuarine waters, with a special emphasis on the Great Lakes. GLERL's research has traditionally been focused on investigations to improve our understanding of, and ability to predict, the biological, chemical, and physical processes occurring in natural ecosystems. Such processes influence the fate and effects of pollutants, the cycling and throughput of nutrients and energy within the food chain, water quality, and water quantity (lake levels and the hydrologic cycle), or they pose a hazard to the human population who use the natural resources of the ecosystem. In addition, GLERL cooperates closely with other federal, state, and local agencies, private industry, academia, and the general public on major environmental projects in the Great Lakes.

Organizational Structure

GLERL is one of eleven environmental research laboratories operated by the National Oceanic and Atmospheric Administration (NOAA).

National Oceanic and Atmospheric Administration
Office of Oceanic and Atmospheric Research
Environmental Research Laboratories
Great Lakes Environmental Research Laboratory
2205 Commonwealth Blvd.
Ann Arbor, MI 48105-1593
Dr. Alfred Beeton
Phone: (313) 668-2235
FTS 378-2235

Individual Lab Descriptions

The GLERL is made up of two divisions, Biogeochemical Sciences and Physical Sciences, whose research programs focus on contaminated sediments and the toxicology of organic contaminants, processes affecting the fate of organic contaminants, lake levels and diversions, ecosystem management, nutrient recycling, physical hazards, climate change, and the introduction of exotic species. There are also a number of support units that provide technical, operational, and administrative assistance to the scientific staff.

GLERL's scientific programs are organized into five coordinated research programs considered critical to the NOAA mission and to Great Lakes problems (Coordinated Ecosystem Research, Climate Variability and Global Change in Large Lakes, Marine Hazards and Water Management, Pollutant Effects, and Non-indigenous Species), the Nutrient Enhanced Coastal Ocean Productivity (NECOP) and CoastWatch programs, and several independent research projects.

Non-Indigenous Species Program

Recently, two species were introduced into the Great Lakes that have the potential to dramatically alter trophic relationships of the entire ecosystem: the zebra mussel and the spiny water flea. The goal of this program is to expand the available knowledge of the biology and ecological impacts of these and other non-indigenous species in the Great Lakes. Individual scientific studies within this coordinated research program include:

- Examining the Impacts of the Zebra Mussel, *Dreissena polymorpha*, on the Lower Food Web of Saginaw Bay

• Metabolic Physiology of the Zebra Mussel, *Dreissena polymorpha*
• Direct Observations on the Trophic Ecology of *Dreissena* Early Life Stages: The Critical Planktonic Period
• Toxicokinetics and Bioaccumulation of Organic Contaminants by the Zebra Mussel
• Zooplankton Grazing vs. Zebra Mussel Filtering in Saginaw Bay: An Experimental and Modeling Study
• Long Term Changes in the Resuspendable Sediments of Saginaw Bay
• Ecology of an Invader: The Physiological Ecology of *Bythotrephes* and its Direct Effect on Food Web Structure in the Great Lakes

Pollutant Effects Programs

The Pollutants Effects coordinated research program pursues research to increase our understanding of the dynamics and effects of contaminants in the ecosystem. The studies are developed within a conceptual framework focused around the basic toxicological concept that effects are related to the attainment of a critical dose of contaminant for a specific duration. This research strives for a generic understanding of contaminant dynamics and effects that can be applied to many different systems using sites and processes from the Great Lakes as specific examples. The effort is a combination of process studies and mathematical modeling that will improve human understanding and ability to predict contaminant fate and effects in the Great Lakes. Individual scientific studies within this coordinated research program include:

• Bioavailability of Sediment-Associated Toxic Organic Contaminants
• Contaminant Effects and the Relationship to Exposure
• Physical and Biological Diagenic Processes in Sediments
• Bioenergetics of the Great Lakes Amphipod *Diporeia* sp.
• Long-Term Trends in Benthic Populations
• Particle Transport and Contaminant Cycling in the Upper Great Lakes

Coordinated Ecosystems Research Programs

The dynamics of Great Lakes ecosystems, including those of their fish populations, are controlled by the actions of humans and nature. Long-term observations of ecosystem components (e.g., the abundance of fish, plankton, nutrients, etc.) demonstrate that they can be highly variable in time and space. Identifying the causes of this variability is a worthy goal because it will lead to an understanding of the relative importance of the influences of humans and nature on ecological dynamics. The goal of the Coordinated Ecosystem Research (CER) program is to improve predictions of ecological change that result from natural and man-made perturbations. The CER program is currently under review and will be reformulated during the upcoming year. Individual scientific studies within this coordinated research program include:

• Microplankton in the Great Lakes: Whole-Lake Biomass and Production Estimates and their Associated Temporal and Spatial Variability
• Food Quality in Pelagic Food Webs
• The Microbial Food Web in the Great Lakes
• Pelagic/Benthic Energy Transfer and Bioenergetics Models of Macroinvertebrates

Nutrient Enhanced Coastal Ocean Productivity (NECOP) Program

NECOP is one of a series of NOAA-wide programs dealing with major problems in the coastal ocean. The central hypothesis is that the increased nutrient input from the Mississippi River has led to increased productivity with undesirable consequences. Individual scientific studies within this coordinated research program include:

• Buoyancy and Nutrient Exchange in the Mississippi Outflow Region
• Retrospective Analysis of Nutrient Enhanced Coastal Ocean Productivity in Sediments from the Louisiana Continental Shelf
• Primary Production and Vertical Flux of Organic Carbon from Mississippi River Plume and Adjacent Shelf Waters
• Suspended Sediment on the

Louisiana Continental Shelf: Concentrations, Compositions, and Transport Pathways
• The Fate and Effects of Riverine (and Shelf-Derived) Dissolved Organic Nitrogen (DON) on Mississippi River Plume/Gulf Shelf Processes

Coastal Programs
Coastwatch is a NOAA-wide program within the Coastal Ocean Program (COP) designed to focus on specific regional and national priorities in the coastal environment. NOAA resources are being brought together to provide a cohesive and near-real time delivery system to allow time-critical "decision support" in response to rapidly emerging coastal environmental situations. GLERL has been chosen as the focal point in the Great Lakes region for this program.

Independent Research Projects
Several independent research projects are also included in the GLERL research program. These projects are considered important to the GLERL mission, but do not currently integrate into one of the coordinated research programs.

• Environmental Radiotracer—This project encompasses studies of diverse aquatic systems and emphasizes the use of radiotracers to identify and model fundamental lake/watershed transport processes.
• Exchange Processes in Coastal Environments—This program seeks to observe, analyze, and quantitatively characterize exchange processes impacting variable fields of environmental concern.
• Carbon Biogeochemistry in Lakes and Coastal Ecosystems—This project focuses on stressors that are transient in nature, e.g., biogeochemical responses to increased or decreased nutrient loads, man-induced changes in the carbon cycle and climate, and the introduction of toxic contaminants and their effects, through research on processes regulating the major biogeochemical cycles and fluxes with an emphasis on carbon.
• Resuspension of Bottom Sediments in Lake Superior—This program seeks to measure the frequency, duration, and magnitude of sediment resuspension episodes using instrumented platforms to experimentally measure erosion threshold velocities using a bottom-resting flume, and to relate these measurements to the properties of the bottom material.
• Dynamics of the Bottom Boundary Layer in Lake Michigan—This study quantifies the distribution of bottom current intensities as functions of space and time in order to parameterize the distribution and frequency of resuspension events.
• Nitrogen Dynamics—This study provides improved methodologies to measure fluxes of important nitrogen compounds that reflect nitrogen dynamics in lakes, wetlands, or marine coastal regions; identifies, quantifies and compares major processes controlling nitrogen regeneration from lake and marine coastal sediments; and identifies and quantifies major nitrogen regeneration processes in lake and/or marine pelagic waters.

Unique Equipment, Facilities or Services
GLERL's research facility is a modern building with over 24,600 square feet of usable space, including 20 laboratories, conference rooms, a library, and computer resources. In addition to general laboratory equipment, GLERL has a fully-equipped low-level radioisotope analysis laboratory, a stable isotope mass spectrometer (SIMS), several gas chromatographs and liquid scintillation coun-ter, a high pressure liquid chromatography system, a multi-channel Coulter Coun-ter, a full complement of growth chambers and incubators, stereo and inverted microscopes, and a fully equipped multi-purpose epifluorescence microscope. GLERL also maintains and operates a High Speed Microcinematography Laboratory housed in a temperature-controlled environmental chamber. In addition, a separate Cold Room is maintained for conducting experiments and growing biological cultures at low temperatures. The GLERL Vessel Operations Facility is located in Muskegon, MI in a former Coast Guard Base which includes three buildings and research vessel dockage.

Computer Facility

The GLERL computer facility can be best characterized as a Local Area Network (LAN) of distributed computing resources. This network currently consists of 8 Vaxs, 10 UNIX/RISC workstations, 60 PCs which are connected by an ethernet, and approximately 20 additional PCs able to access the network via a communications switch. The LAN is connected to the Internet via a router to MichNet.

A variety of scientific applications, including real-time and near real-time data acquisition, data reduction, graphics, large scale modeling, statistical and mathematical analysis, electronic mail, and remote file transfer are accessed by GLERL personnel and collaborators.

The Computer and Information Systems Group continued the inventory of databases archived at GLERL. The program is an ongoing activity and contributes to the larger-scale NOAA effort of archiving usable data and making that data available for use by all interested scientists. The following is a listing of the database categories:

- Current Meter and Water Temperature
- Drifter Data
- Wave Data
- Computerized Bathymetry Data
- Meteorological Data (Air Temperature, Wind Speed and Direction)
- Vertical Velocity Profiles
- Biological and Chemical Water Data
- Sediment Trap Data (Mass Flux, Some Chemical Characteristics)
- Water Data (Temperature Profiles)
- Water Temperature Data XBT
- Water Data (Temperature, Salinity, Transparency, etc.)
- Water Characteristics (Chemical, Physical, Bottom Sediment, etc.)
- Shipboard Meteorological Data

Library

The GLERL library has a program-oriented research collection maintained in support of the laboratory's research activities. The collection reflects an emphasis upon freshwater studies - particularly in the Great Lakes Basin.

The GLERL library is a member of the Michigan Library Consortium (MLC), Washtenaw-Livingston Library Network (WLLN), Federal Library and Information Network (FEDLINK), NOAA library and Information Network (NLIN), and the Online Computer Library Center (OCLC).

Vessel Operations

GLERL maintains the Vessel Operations Facility in Muskegon, MI. The facility is comprised of several buildings which house offices, a workshop, and storage space for ship supplies and equipment. Dockage space is also available nearby for research vessels. GLERL owns and operates several research vessels including the *Shenehon*, the primary platform used in support of GLERL's open lake field investigations, a 23-foot Monark workboat, and a 28.5-foot SeaArk workboat.

Marine Instrumentation Laboratory

The marine instrumentation laboratory (MIL) staff select, calibrate, repair, and, when necessary, adapt or design instruments to collect data in the lakes and their environs. Engineers and technicians in this unit work closely with GLERL researchers to ensure that instruments are compatible with their needs. They also participate in field experiments by providing support for the deployment and retrieval of field equipment, assistance with the collection of samples and data, and in-field maintenance or repair of equipment. GLERL's data collection equipment includes 44 AMF Vector Averaging Current Meters, 16 AMF Acoustical Releases, 7 Mini-TOD Drifter Buoys, 1 Adamo-Rupp Waverider WRIPS Buoy, 5 Aanderaa Thermistor String Recorders, 5 Marsh McBirney 585 Current Meters, 1 RD Instrument CO. RDRR-1200 Acoustical Doppler Current Profiler, and 2 RDSC-600 Acoustical Doppler Current Profilers.

Armstrong Laboratory

Lab Description

Armstrong Laboratory conducts research, advanced development, and specialized operational support on the readiness, maintenance, protection and enhancement of human capabilities. Its focus is on defining the human interface with new operational systems and assisting in the engineering process to ensure the safety and effectiveness of personnel.

Organizational Structure

Armstrong Laboratory conducts research through five major technology directorates which are each composed of divisions. Three directorates, the Crew Systems Directorate, the Occupational and Environmental Health Directorate, and the Human Resources Directorate, have divisions located at Wright-Patterson AFB in Ohio.

Headquarters
Armstrong Laboratory
AL/XPTT (ORTA)
2509 Kennedy Drive
Brooks AFB
San Antonio, TX 78235-5118
Mr. Doug Blair, Chief, ORTA
Phone: (210) 536-2838
FAX: (210) 536-2810

Operating Facility
Armstrong Laboratory
AL/CFA
Wright-Patterson AFB, OH 45433-6503
Mr. Scott Hall
Phone: (513) 255-2273
FAX: (513) 255-2019
E-Mail:
PHALL@EAGLEB.AAMRL.WPAFB.AF.MIL

Individual Directorates Descriptions

Crew Systems Directorate – This Directorate is comprised of three technical divisions with two located at Wright-Patterson: the Biodynamics and Biocommunications Division and the Human Engineering Division. The Biodynamics and Biocommunications Division studies the limitations of the human to mechanical stresses of noise, vibration, impact, and acceleration for the purpose of design criteria, protection devices, and improved human/machine interfaces. The Human Engineering Division develops methodologies, tools and standards to help system designers take maximum advantage of human capabilities to maximize total system effectiveness. The third division, Crew Technology, is located at Brooks Air Force Base. This Division focuses on improving human performance and safety through a better understanding of the operational stress environment. All the divisions complete basic, exploratory and advanced development research in the topics discussed above.

Occupational and Environmental Health Directorate - Toxicology Division – The Toxicology Division provides a resource facility sharing approach to toxicology research where the government-owned, contractor-operated toxic hazards research unit, pathology services, veterinary services, and existing office and laboratory facilities are equitably shared and cofunded with the Navy and Army. It also conducts in-house and contractual research providing operational support to assure the occupational and environmental safe use of Air Force chemicals and materials. This Division determines hazardous human effects, toxicological

mechanisms and fate and distribution of Air Force chemicals and materials. State-of-the-art modeling is used to understand and predict toxic health effects prepare chemical health risk assessments. It also acts as principal consultant to the Air Force for occupational and environmental toxicology research.

Human Resources Directorate, Logistics Research Division – The Logistics Research Division performs research and development focused on technology for improving performance of integrated systems of people, information, and equipment doing essential acquisition and combat support functions. This includes developing automated job aids and integrating diagnostics for maintenance, information trade-off techniques and design tools for concurrent engineering that allow consideration of weapons systems operability and supportability from design inception. Applications cover a broad spectrum throughout the Air Force, DOD and other agencies.

Unique Equipment Facilities or Services

Special equipment located at the Wright-Patterson facilities include:

- A Dynamic Environment Simulator, a man-rated centrifuge with a 20-ft arm, capable of producing sustained accelerations of up to 20g in combination with three-degree-of-freedom motion of the payload.
- An impulse accelerator and a terminal impact decelerator combined in a single track
- A 50-ft drop tower
- A 1000g precision impact device
- A six-degree-of-freedom device
- A 20-ft displacement vertical accelerator
- Five one-degree-of-freedom vibration devices
- A dynamic pressure chamber (infrasound and sonic boom simulation)
- Multiple wideband acoustic simulators employing reverberation and anechoic exposure chambers.
- An image metrics laboratory which provides full capability for both quantification of visual/display stimuli and measurement of human psychophysical response mechanisms

The Toxic Hazards Division has earned an internationally recognized capability for inhalation toxicology centered around unique exposure chambers called Thomas Domes. These domes are large

glass-paneled structures, 12 feet in diameter and 9 feet high, which permit unrestricted visual and photographic observation of experiments in progress. The domes have an altitude capability and are air-locked to permit entry during long, continuous exposures without disturbing the exposure parameters. These design features make them particularly well suited for handling highly toxic and suspect carcinogenic chemicals. The exposure facility includes numerous other commercial chambers and has associated with it a hands-off gas mixing facility used to generate and maintain precise concentration levels of hazardous materials common to the missile industry.

Unique Personnel Expertise

The laboratory employs a work force of approximately 1,500 people, of which over 650 are scientists and engineers. A majority of these professionals have advanced technical degrees. More than one-third of them have doctoral degrees.

Patents for License

Numerous patents exist within the Laboratory. Many of these patents are appropriate for licensing to commercial applications. In some cases, through the use of Cooperative Research and Development Agreements (CRDAS), technology can be further developed and patents developed with associated license agreements.

CRDAs

The laboratory has entered into a number of CRDAs to facilitate the commercialization of its technology. Collaborating with industry and academia to further develop technology for the commercial marketplace is a primary technology thrust of the laboratory. Examples of CRDAs and partnership opportunities include working with a local hospital to adapt crew protection devices to the care of trauma patients and other emergency room health care; developing a high purity oxygen generator; converting a previously DoD color display technology for use in air-traffic control purposes; adapting human ergonomic crew station design software to the assessment of physically challenged working and living environments; and applying audio display systems to general aviation, entertainment, and education markets.

Department of Defense

Ceramics Information Analysis Center

Lab Description

The Ceramics Information Analysis Center (CIAC) is the Department of Defense's central source for information on monolithic ceramics and ceramic composites, hybrids, laminates and coatings used in defense systems and hardware. CIAC's mission is to compile, maintain, computerize and store information and data regarding ceramics materials.

Ceramics Information Analysis Center
CINDAS/Purdue University
2595 Yeager Rd.
West Lafayette, IN 47906-1398
Dr. C.Y. Ho, Director
Dr. Said K. El-Rahaiby, Assistant Director
Mr. James F. Chaney, Assistant Director for Inquiry and User Support Services
Phone: (317) 494-9393
FAX: (317) 496-1175

Organizational Structure

CIAC is a Department of Defense Information Analysis Center operated by the Center for Information and Numerical Data Analysis and Synthesis (CINDAS) of Purdue University for the DOD. CIAC is under the sponsorship of the Office of the Director of Defense Research and Engineering (Research and Advanced Technology), Mr. Jerome Persh, and under the management of the Defense Technical Information Center (DTIC), Dr. Forrest R. Frank.

Unique Equipment, Facilities or Services

CIAC compiles scientific and technical information and engineering data in the following subject areas:

- Monolithic ceramics
- Borides, carbides, graphites, nitrides, oxides, sulfides, silicides, glasses and glass ceramics.

- Ceramic matrix composites
- fiber, whisker-, particulate-, platelet-, reinforced matrix composites; cermets (metal-reinforced) and fiber-reinforced glasses.
- Reinforced fibers and whiskers
- Ceramic Coatings
- Coatings used in critical structural and thermal applications and/or in other stringent environments.
- Non-structural composites
- Piezoelectric-ceramic materials, optical ceramics, superconducting ceramics.
- Mechanical properties
- tensile, compressive, lexural, shear, fatigue, creep failure, fracture toughness and elastic constants
- Thermophysical and physical properties
- thermal expansion, thermal conductivity, thermal shock resistance, heat capacity, O2/H2 compatibility, density and viscosity.

CIAC provides information on technical areas such as:

- Up-to-date research and development concepts, results and trends
- Applications and processing of materials and equipment
- Measurement of properties and behavior analyses
- Test analysis and consultation
- Quality control related to materials
- Corrosion/deterioration detection, prevention and control, and other environmental effects of materials and systems
- Producers, suppliers and specifications for materials.

CIAC also offers several services including bibliographic services, technical data and information, technical area tasks, and conferences, workshops, and short courses.

CIAC offers special projects such as handbooks, databooks, and also prepares critical reviews and technology assessments, and state-of-the-art reports on technology related to the reliability, performance, and processibility of advanced ceramic materials.

Department of Defense

Crew System Ergonomics Information Analysis Center

Lab Description

The Crew System Ergonomics Information Analysis Center (CSERIAC) is a gateway to worldwide sources of up-to-date human factors and ergonomics information and technologies for designers, engineers, researchers, and human factors specialists. CSERIAC specializes in the timely acquisition, analysis, and dissemination of scientific and technical information concerning human performance, abilities, limitations, physiological needs and tolerances, body dimensions, biomechanical dynamics, and physical strength. This information also includes engineering and design data concerning equipment operated, maintained or controlled by humans in sea, land, air, and space environments. Subject areas include: acquisition of information through visual, auditory and other senses; perceptual organization; attention allocation; information storage and retrieval, operator motor control; effect of environmental stress; operational work-load, and control and display interfaces both real and virtual.

Crew System Ergonomics Information Analysis Center
AL/CFH/CSERIAC
Building 248
2255 H Street
Wright-Patterson AFB, OH 45433-7022
Mr. Don A. Dreesbach
Phone: (513) 255-4842
FAX: (513) 255-4823
Internet:
DDreesbach@FALCON.AAMRL.WPAFB.AF.MIL

Unique Equipment, Facilities or Services

CSERIAC's principal products and services include:

- technical advice and assistance
- customized responses to bibliographic inquiries
- written reviews and analyses in the form of state-of-the-art reports and technology assessments
- reference resources such as handbooks and data books
- CSERIAC Gateway, no-charge current awareness bulletin

Within its established scope, CSERIAC also:

- organizes and conducts workshops, conferences, symposia, and short courses
- manages the transfer of technological products between developers and users
- performs special studies or tasks

Services are provided on a cost-recovery basis. An initial inquiry to determine available data can be accommodated at no charge. Special tasks require approval by the Government Technical Manager:
Dr. Reuben L. Hann
AL/CFHA Building 248
2255 H Street
Wright-Patterson AFB, OH
45433-7022
Phone: (513) 255-8821
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WPAFB.AF.MIL

Department of Defense

Developmental Manufacturing and Modification Facility

Lab Description

This facility's mission is to support the needs of all Department of Defense agencies, private industry and Foreign Military Sales customers in the areas of:

- Test and evaluation
- Major/minor aircraft modification
- Quick reaction aircraft modifications
- Temporary and prototype modifications
- Research and developmental fabrication
- Prototype/limited manufacturing
- Selected technology demonstration and transfer to the Air Logistics Centers (ALCs) and private sector in partnership with Aeronautical Systems Center (ASC) Engineering and Wright Laboratories.

Developmental Manufacturing and Modification Facility
Business Office
Wright-Patterson AFB, OH 45433-6513
Mr. Dave Rumer
Phone: (513) 257-3751
FAX: (513) 257-9972

Unique Equipment, Facilities or Services

The facility has several unique resources including 114,000 sq.ft. of aircraft modification hangars, 54 CAE workstations for hands-on engineering, a 250,000 sq. ft. fabrication facility, an autoclave (8' x 20', 800°F, 300psi), 6-axis milling machine, multi-layer printed circuit boards, stereolithography, 49 CNC machines, and two parallel runways.

Unique Personnel Expertise

The Developmental Manufacturing and Modification facility (DMMF) has a highly skilled and dedicated workforce with decades of experience in manufacturing and aircraft modifications. They work together to complete in-house aircraft modification design, structural analysis, fabrication and installation.

The DMMF has become involved in several significant new mission areas in support of and in partnership with:

- Wright Laboratories to provide an industrial environment for the laboratory to accomplish selected in-house technology demonstration and transfer.
- The Wright-Patterson AFB community for a corporate learning experience in Integrated Product Development (IPD) and Integrated Business Management (IBM).
- The Air Logistics Centers by enhancing their ability to compete through prototyping, special tooling and developmental support.

CRDAs

The DMMF is interested in entering into CRDAs of mutual benefit with interested parties. Contact Dave Rumer for more information.

Electronics Manufacturing Productivity Facility

Electronics Manufacturing Productivity Facility
714 North Senate Ave.
Indianapolis, IN 46202-3112
Mr. William J. Baldwin
Phone: (317) 226-5607
FAX: (317) 226-5615

Lab Description

The Electronics Manufacturing Productivity Facility (EMPF) is a national agent for the identification, development, and deployment of electronics assembly level packaging manufacturing technologies, processes, practices and materials to improve the productivity and competitiveness of the electronics industry. The EMPF teams with industry, academia and government to jointly identify, develop, transfer and implement innovative electronics manufacturing technologies, processes and practices to domestic firms.

Organizational Structure

EMPF is a federally sponsored National Center of Excellence founded through a unique Cooperative Research and Development Agreement (CRADA) between the Naval Surface Warfare Center, Crane Division, Naval Air Warfare Center, Aircraft Division, Indianapolis, and Indiana University-Purdue University at Indianapolis.

Unique Equipment, Facilities or Services

The EMPF is well positioned to play a significant role in the domains of both the technology developer and user. Human resources available at the EMPF include faculty, engineers and technicians competent in applied research, design, development, testing and manufacturing of electronics products. The Demonstration Factory and the Electronics Manufacturing Learning Center (EMLC) foster user awareness, assist in the future project selection process, encourage commitment and assist in technology implementation. Additionally, EMPF deploys technology through a variety of mechanisms in both the commercializable and non-commercializable segments including new projects, cooperative R&D, publications, opportunities for licensing, seminars, workshops, courses, training and consulting.

Consulting

One of the most prominent methods of technology deployment utilized by the EMPF and its customers is in the form of consulting. Much of the consulting that occurs throught the EMPF is informal in nature and is the result of relationships developed with EMPF and industry personnel over time. The Help line service that is provided by the EMPF is key to initiating these relationships and is one of the primary tools for EMPF consulting. The Help line function provides representatives from other organizations with the ability to access the EMPF, and the right personnel within the EMPF, for help. The goal of the consulting function is to deploy technology to as many organizations as possible and make this process non-threatening to those who need help.

The EMPF consulting effort is designed to provide an easily accessible resource to electronics manufacturers for the purpose of technology transfer/deployment. The Help line, a primary tool for accessing the EMPF, will provide customers with up to 16 hours of free service to help them resolve these problems. Additional methods of consultation will be provided for the purpose of transferring technology. Those include: Demonstration Factory, Shared Factory, EMLC, Tech Library, resources at NAWC ADI, Crane Division NSWC, and points of contact outside the EMPF.

The EMPF, in instances where assistance is required outside of the EMPF's area of expertise, will attempt to utilize existing networks to bring organizations together. This linkage is made possible through the increasing network being developed by the EMPF with other organizations.

The primary customers of the EMPF consulting services are defense and commercial electronics manufacturers, large/medium/small sized businesses, government agencies, academic institutions, and the CRADA partners. Implementation of technologies provided through consulting efforts will be stressed, as this is the goal of technology deployment.

Technology Deployment Liaison

The Technology Deployment Liaison function is tasked to bring together the efforts of the EMPF and evaluate them with a focus on technology deployment. This function identifies opportunities for technology transfer resulting from EMPF research projects. This function is responsible for creating an awareness of technology deployment within the technical community at the EMPF. The Technology Deployment Liaison is also responsible for assisting the project personnel in the commercialization of products that are developed as a result of EMPF research.

External to EMPF research, the Technology Deployment Liaison will work to increase the existing network of organizations performing work on electronics manufacturing technologies. This network provides for two way communication for the purpose of transferring pertinent technologies.

There are two main groups of customers for the Technology Deployment Liaison efforts and they can be grouped as those internal to the EMPF and those external to the EMPF. Internal customers are primarily the EMPF project personnel. Efforts for internal customers will be focused on the technologies resulting from research projects that have the potential to impact the electronics manufacturing industry through either commercializable or non-commercializable means. External customers are primarily the technology users in industry and DOD. Efforts will be undertaken to better understand the needs of the technology users and to identify technologies available external to the EMPF that could impact current and future EMPF projects.

Demonstration Factory

The Demonstration Factory is the unique feature which sets the EMPF apart from all other technology development/deployment organizations. The Demonstration Factory is embodied by the EMPF's physical assets which support virtually all phases of the EMPF including technology development, technology deployment, and education and training programs. Board level electronics assembly techniques are demonstrated in a factory environment setting, thereby encouraging the adoption of new technologies in American electronics manufacturing operations.

Virtually all aspects of the EMPF are served by the Demonstration Factory, and the majority of the EMPF's external clients are customers of the Demonstration Factory, whether they are students attending EMLC classes or manufacturers needing a technology demonstration or contract assembly. The Demonstration Factory provides support to most of the EMPF's internal organizations as well by providing all manufacturing facilities for research projects and demonstration and teaching facilities for the EMLC.

A vast majority of the equipment utilized in the Demonstration Factory is either loaned or donated by electronic equipment manufacturers at no cost to the EMPF or the Government.

Education

The curricula for the Electronics Product Realization education program will be developed in conjunction with IUPUI and other universities. The curricula will teach the principals of design and manufacture of electronic products. A Capstone project will require students to conceive a product that has commercial potential.

As seniors, they will work together, as a team, to design the product, order the parts and assemble the product, followed by final test and evaluation. These students will be supported by faculty and EMPF engineers. In school year FY93-94, engineering and technology students at IUPUI will be able to graduate with an option in electronics manufacturing.

Faculty will be responsible for the development of curricula, syllabi, and instructional materials. The EMPF engineering staff will assist as required. In particular, they will participate as guest lecturers in topical areas.
The products and services offered include:

- education curricula, syllabus and instruction development by faculty and EMPF engineers
- faculty grants to stimulate and support involvement in the EMPF

Labs involving hands-on projects which students produce functional electronic assemblies utilizing various packaging technologies, equipment, and processes.

Electronics Manufacturing Learning Center

A vital part of the EMPF's mission is to improve the exchange and transfer of technology between businesses, government and academia. One way EMPF accomplishes this is through its EMLC, which offers the following four types of training services.

Skills Training Courses - The skills training course program directly addresses productivity on the factory floor, the one factor most crucial to a company's success. With hands-on training on actual production equipment, led by highly skilled personnel, the skill training courses provide individuals with the most up-to-date, respected technical training available.

Seminars - Seminars are offered on current EMPF research projects and/or emerging electronic manufacturing technologies. The EMLC also conducts seminars on risk assessment/management in "Transition from Design to Production," or "Template" training, in conjunction with the Department of the Navy. EMLC Seminars give engineers, managers, and senior technicians opportunities for professional growth. Organizations are invited to arrange for seminars, or to collaborate with the EMLC on customized seminars.

Workshops -In workshops, which are less formally structured than seminars, representatives from industry, government and academia meet to identify electronic manufacturing challenges (including training needs) and to propose research projects. All participants at a workshop contribute towards proposing a solution or defining a process. These cooperative efforts provide excellent vehicles for improved communication in the electronics manufacturing community.

Customized Training - The EMLC is able to draw from its extensive resources and expertise in electronics manufacturing processes and technologies to develop training classes and materials to meet the unique needs of any organization. The subject matter, method and location of delivery, level of detail, and degree of involvement by EMLC personnel can be tailored to meet each organization's requirements.

Communications

The communications function is an integral part of technology deployment at the EMPF. Through its publications and public affairs and library support, the communications group constitutes the primary means for distribution of research results, as well as corporate image marketing. The publications area readies research results/information for publication/presentation; the public affairs area supports the dissemination of information; and the EMPF library serves as a repository for both technical documentation and marketing tools, as well as a source for background information for EMPF research efforts. Customers of the EMPF communications function include EMPF managers and staff, EMPF CRADA partners, sponsors, and constituency groups, and U.S. electronics manufacturers and educators.

Unique Personnel Expertise

Courses and seminars available -
Cathy Baker
(317) 226-5640

Electronics Manufacturing Productivity Facility Helpline
(317) 226-5607

Customized Training in Electronics Manufacturing - Dr. Larita Killian
(317) 226-5609

Technology Deployment Information
Mr. Bill Baldwin
(317) 226-5688

Technology Development Project Information -
Mr. Jim Kreusch
(317) 226-5610

Demonstration Factory Information -
Mr. Rick James
(317) 226-5619

EMPF Communications -
Ms. Debbie Edwards
(317) 226-5637

Department of Defense

Environmental Technical Information System

Lab Description
The Environmental Technical Information System (ETIS) is a collection of environmental databases located at the University of Illinois that provides planners, economists, decision-makers and environmental specialists with current environmental information.

Organizational Structure
ETIS is a Department of Defense facility located at the University of Illinois and is funded by the U.S. Army Construction Engineering Research Laboratory in Champaign, Illinois.

Unique Equipment, Facilities or Services

Databases
ETIS' primary databases are:

- *Economic Impact Forecast System (EIFS)*- EIFS functions both as an information tool and an analytical tool by providing users with selected statistics regarding the socioeconomic characteristics of any county or multi-county area in the United States and an analytical process for assessing the magnitude and significance of potential socioeconomic impacts of proposed activities on these areas.
- *Computer-aided Environmental Legislative Data System (CELDS)*- CELDS is a database containing abstracted federal and state environmental regulations and standards.
- *Soils Systems (SOILS)*- The SOILS systems allow easy access to Soil Conservation Service data by soils series name or by entering a combination of desired soil characteristics.
- *Environmental Impact Computer System (EICS)*- EICS is an interactive system which enables a user to determine how any activity may affect various aspects of the environment.

Environmental Technical Information System
Department of Urban and Regional Planning
University of Illinois at Urbana-Champaign
1003 West Nevada St.
Urbana, IL 61801
Ms. Elizabeth Dennison
Phone: (217) 333-1369
FAX: (217) 244-1717
E-mail: support@osiris.cso.uiuc.edu
dennison@osiris.cso.uiuc.edu

Environmental Information Connection
The Environmental Information Connection is a search service staffed by professional librarians. Search requests can be filled through online searching or by utilizing the extensive resources available at the University of Illinois library.

Unique Personnel Expertise
CELDS-Project Coordinator: (217) 244-5362
SOILS-Kim Majerus (800) USA-CERL ext. 372

Department of Defense

High Temperature Materials Mechanical, Electronic, and Thermophysical Properties Information Analysis Center

Lab Description

HTMIAC serves as the DoD's central source of engineering data and technical information on high temperature materials properties, especially the properties of aerospace structural composites and metals and infrared detector/sensor materials. Such data and information are for the Defense research, development, engineering, and acquisition programs, weapons systems, and military hardware in general and for high energy laser structural and detector vulnerability, survivability, and hardening assessments and studies in particular. Materials and properties covered are as follow:

Materials — Graphite/epoxy composites, graphite/polyimide composites, Kevlar/epoxy composites, carbon/carbon composites, carbon/phenolic composites, fiberglass/epoxy composites, graphite/bismaleimide composites, silica/phenolic composites, selected aluminum and titanium alloys and stainless steels, selected infrared detector/sensor materials, selected electromagnetic-transparent materials, selected thin films, and selected switching materials.

High Temperature Materials Mechanical, Electronic and Thermophysical Properties Information Analysis Center
CINDAS/Purdue University
2595 Yeager Road
West Lafayette, IN 47906-1398
Dr. C.Y. Ho, Director
Dr. R. H. Bogaard, Assistant Director
Mr. James F. Chaney, Assistant Director for Inquiry and User Support Services
Phone: (317) 494-9393
FAX: (317) 496-1175

Themophysical, Thermoradiative, Optical and Electronic Properties — Ablation energy, ablation temperature, absorptance, absorption coefficient, boiling point, density, electrical resistivity, emittance, heat capacity, heat of fusion, heat of vaporization, melting point, moisture expansion, reflectance, refractive index, thermal conductivity, thermal diffusivity, thermal expansion, and transmittance.

Mechanical Properties — Compressive modulus, compressive strength, elastic constants, elongation, energy release rate, flexural modulus, flexural strength, fracture toughness, hardness, impact energy Poisson's ratio, reduction in area, residual strength, shear modulus, shear strength, stress-strain curves, tensile modulus, tensile strength, ultimate strain at fracture, and yield strength.

HTMIAC supports the DoD in general and is specifically designated to support the Tri-Service Laser Hardened Materials and Structures Group (LHMSG) in particular. It also provides similar support to the DoD high energy laser community associated with the Strategic Defense Initiative (SDI) programs.

Organizational Structure

HTMIAC is a Department of Defense Information Analysis Center operated by the Center for Information and Numerical Data Analysis and Synthesis (CINDAS) of Pur-due University for the DoD. HTMIAC is under the sponsorship of the Office of the Director of Defense Research and Engineer-

ing (Research and Advanced Technology), Mr. Jerome Persh, and under the management of the Defense Technical Information Center (DTIC), Dr. Forrest R. Frank.

Unique Equipment, Facilities or Services

High Temperature Materials Properties Numerical/ Technical Database

The computerized High Temperature Materials Properties Database as of May 31, 1992 contained 22,187 sets of data, including 17,601 sets of unrestricted data in an on-line database and 4,586 sets of restricted data in a controlled database. These data cover 720 materials, 231 properties, 342 parameters, and 108 independent variables.

The materials covered are 405 varieties of aerospace structural composites (including 23 varieties of carbon/carbon composites, 61 varieties of carbon/phenolic composites, 65 varieties of fiberglass/epoxy composites, 12 varieties of graphite/bismaleimide composites, 142 varieties of graphite/epoxy composites, 25 varieties of graphite/polymide composites, 54 varieties of Kevlar/epoxy composites, 17 varieties of silica/phenolic composites, and 6 varieties of nylon/phenolic composites), 126 varieties of composite constituents, 107 varieties of aerospace structural alloys, 64 varieties of infrared detector/sensor materials, and 18 other materials (including 3 varieties of alumina, 3 varieties of boron nitride, 9 varieties of graphite, 1 polycarbonate, and elemental metals).

The properties covered are 48 thermophysical and thermoradiative properties, 22 electronic, electrical, and optical properties, and 161 mechanical properties. The parameters covered include 199 general parameters, 118 construction configuration parameters for composite materials, and 25 material environment parameters.

Since material property data are meaningful only if adequate information on the test material and on the property measurement is also provided, each set of data in this database consists of numerical data points (as a function of temperature and/or other independent variable) and pertinent information on the specification and characterization of the test material and on the method and conditions of the property measurement, such as composition, purity, density, porosity, microstructure, material construction configuration, material processing, sample preparation, specimen geometry and dimensions, material history, heat treatment, surface condition, producer, supplier, method of measurement, test environment, heat flow direction, heating rate, heat-up time, heat-up temperature, holding time at temperature, type of heat source, and loading rate, insofar as these are contained in the original document.

This database is online operated since January 1988 to provide on-line numerical/technical database service to the DoD and DoD-contractor community. Since the database operating system is menu-driven, no special query language or commands need to be learned by the user. Numerical data are retrievable in graphical as well as tabular forms.

High Temperature Materials Properties Bibliographic/Literature Database

This computerized bibliographic/literature database as of May 31, 1992 contained 26,145 pertinent documents on the mechanical, thermophysical, thermoradiative, electronic, electrical, and optical properties of aerospace structural composites and metals and infrared detector/sensor materials.

Database for Laser Effects (DABBLE)

This computerized PC-based Database for Laser Effects contains data on high energy laser-materials interaction effects and also data on the properties of the laser tested materials. It is maintained by HTMIAC/CINDAS as the official repository for laser-materials interaction effects data for the Air Force Wright Laboratory. Operating in a classified mode, DABBLE has been distributed since 1990 on diskettes to interested and authorized users with security clearance and classified facility

for use on personal computers.

HTMIAC Reports
HTMIAC can provide reports regarding materials, properties, literature, and data. Call for further information.

Department of Defense

Industrial Engineering Activity

Lab Description

The Activity's mission is to provide engineering, technical and management services to the Army in support of production readiness and industrial preparedness planning. The staff provides consultant advice and performs assessments of on-going programs.

Industrial Engineering Activity
AMXIB
Rock Island, IL 61299-7260
Mr. John Holvoet
Phone: (309) 782-5010
FAX: (309) 793-7170

Unique Personnel Expertise

Areas of technical skills include:

- Product design and engineering
- Producibility analysis
- Production engineering
- Value engineering
- Electronic product data
- Technical data management
- Computer integrated manufacturing
- Industrial base analysis
- Mobilization planning
- Plant equipment management
- Pollution prevention

Department of Defense

Infrared Information Analysis Center

Infrared Information Analysis Center
P.O. Box 143001
Ann Arbor, MI 48113-4001
Mr. Irvin Sattinger
Phone: (313) 994-1200 Ext. 2245
FAX (313) 994-5550
TELEX 4940991 ERIMARB

Lab Description

The Infrared Information Analysis Center (IRIA) was established in 1954 to facilitate information exchange within the Department of Defense (DoD) infrared community. Its ongoing mission is to perform the functions of a full-service DoD Information Analysis Center, with its mission now extended to cover the entire field of electro-optic technology. It is the single focal point within DoD for information, methodologies, models and analyses relating to U.S. and foreign aerospace and surface weapons utilizing infrared or electro-optic devices and systems.

Organizational Structure

IRIA is a facility within the Department of Defense and is administratively managed by the Defense Technical Information Center (DTIC).

Unique Equipment, Facilities or Services

The subject areas covered by the IRIA Center include radiation sources emitting in the ultraviolet through infrared regions; radiation characteristics of natural and man-made targets; optical properties of materials; detection materials, detector elements and arrays; lasers; image tubes and sensors; optical systems and components; detector coolers and electronics; atmospheric propagation including absorption, emission, scattering, and turbulence effect; and search, homing, tracking, ranging, countermeasures, reconnaissance, and other military optical, infrared, and laser systems.

The IRIA Center provides the following products and services to the scientific and technical community:

- Maintains the IRIA Library, whose holdings currently exceed 50,000 items consisting of government documents, proceedings, journal articles, and books in subject areas related to the IRIA mission.

The IRIA Library is located at the headquarters of the Environmental Research Institute of Michigan (ERIM) in Ann Arbor, Michigan. The size of the library collection is currently over 50,000 items and includes government R&D reports, journal articles, proceeding papers, and informal reports. The library specializes in limited distribution and classified report literature, but unclassified documents are also included. Since the collection also serves as a national reference library for the DoD community, strict attention is paid to need-to-know requirements and distribution limitations.

Qualified users may arrange a visit to the library by calling the IRIA Center to identify the specific area of interest and to select a suitable visit date, and forwarding the necessary security clearance and need-to-know. Before the date of the visit, the IRIA staff will search its database to select suitable documents for review. For security reasons, "browsing" is not permitted.

Documents held in the IRIA Library are not available for loan or reproduction. However, bibliographic data can be provided to enable the user to order the item from the Defense Technical Information Center (DTIC), the IRIA Center, or other sources.

• Operates a database of bibliographic records of IRIA Library holdings.

The IRIA bibliographic database is currently on a DEC VAX computer in the ORACLE relational database management system. It provides bibliographic and abstract information on all documents in the IRIA Library. To facilitate subject searching of the database, the dictionaries of retrieval terms are continually reviewed and modified when necessary to better describe the reports in this rapidly expanding field.

Because of security restrictions, as well as the complexity of the subject matter, the database is not directly accessible to the user, but must be searched by the IRIA Center staff. The staff selects search procedures on the basis of a preliminary conversation with the user to identify appropriate retrieval terms on which to base the search.

It is possible to search the database by selecting the primary subject category best describing the contents of individual documents, key words or combinations of key words covering technical topics discussed in the document, words used in the titles of documents, and personal or corporate authors. Also, the search can be restricted to documents published in selected time periods.

• Responds to technical and bibliographic inquiries from qualified users.

Members of the IRIA staff are available to respond to technical and bibliographic inquiries from qualified users. Users should contact the IRIA Center and discuss their needs with a member of the technical staff. If classified information must be discussed, contact with the Center should be by written communication with appropriate classification.

The IRIA Center, especially in responding to inquiries, makes use of its extensive library and the associated classified bibliographic database and consults other members of the Institute staff. It also maintains a familiarity with the open literature. The IRIA staff can search other on-line systems such as DIALOG, DTIC's DROLS, and TRISIG. The Center also maintains extensive files of names and addresses of people active in the field.

The extent of the Center's response to individual inquiries is necessarily limited. If a more comprehensive analysis of a problem is justified, special funding may be provided to the Center through a purchase order or a Military Interdepartmental Purchase Request (MIPR) form to conduct such studies. A special study can take advantage not only of the experience of the Center's technical staff but that of other scientists and engineers at its parent organization, ERIM.

In addition to the inquiries which concern technical subject matter, the Center responds to many questions from engineers, their secretaries, and librarians about particular documents or individual papers, concerning their availability, security downgrading, order numbers, or authors' addresses. An even larger volume of questions are answered concerning the dates, deadlines, or eligibility-to-attend for the IRIS meetings.

• Conducts the annual National Infrared Information Symposium (IRIS) and meetings of the seven IRIS Specialty Groups, as well as related meetings supported by DoD agencies.

The IRIA Center conducts the classified annual Infrared Information Symposium (IRIS) and annual meetings of the six IRIS Specialty Groups (Active Systems; Infrared Countermeasures; Infrared Detectors; Infrared Materials; Passive Sensors; and Targets, Backgrounds and Discrimination). It also conducts other technical meetings or workshops in subject areas closely related to its primary responsibilities. Currently, it conducts a by-invitation-only Electro-Optics Countermeasures Colloqium. The meetings provide an excellent opportunity to

keep up with the newest technical developments in infrared and electro-optics and to meet with other scientists and engineers in these fields. A total of 380 papers were presented at the meetings held during 1988 and the total attendance was 2317 people. The proceedings of most of these meetings are published and distributed to IRIA subscribers and other qualified users.

An employee of a subscriber organization may attend the IRIS meetings at a reduced registration fee. Announcements regarding upcoming meetings are included in *Spectral Reflections*, the IRIA newsletter. Detailed information on the meetings and the necessary security and registration forms are provided in general information mailings to subscribers.

It is possible to attend IRIS meetings without being an IRIA Center subscriber. Both Department of Defense and Department of Energy security clearances will be accepted, but the attendee must have a DoD need-to-know and must pay a non-subscriber's registration fee to attend the meeting.

Department of Defense

Manufacturing Technology Information Analysis Center

Manufacturing Technology Information Analysis Center
IIT Research Institute
10 West 35th St.
Chicago, IL 60616
Ms. Michal Safar
Phone: (312) 567-4730, (800)421-0586
FAX: (312) 567-4736
E-Mail: msafar@dgis.dtic.dla.mil

Lab Description

The Manufacturing Technology Information Analysis Center (MTIAC) is responsible for the collection, analysis and dissemination of manufacturing technology information and data in the following areas: metals, non-metals, quality, electronics, munitions, Computer Aided Design/Computer Aided Manufacturing (CAD/CAM).

Manufacturing technology information and data are acquired and disseminated in the following defense-related fields: machine tools and manufacturing equipment, robots and special machines, material handling equipment, controls, software and databases, communication lines and networks, sensors and inspection or checkout procedures, signal processing, materials and materials handling, production processes, specific defense-related products and the management aspects of manufacturing technology.

Organizational Structure

MTIAC is administratively managed and funded by the Defense Technical Information Center (DTIC).

Unique Equipment, Facilities or Services

MTIAC provides products and services to all levels of the U.S. manufacturing community — military, civil and academic. These include:

- Technical inquiries
- Bibliographic inquiries
- Handbooks and directories
- State-of-the-art reports
- Technology assessments
- Bibliographies
- Special reports
- User manuals
- Referrals
- Manufacturing Technology Database
- SIMON Database
- MTIAC on-line services
- Customized research
- Current Awareness Bulletin
- Conference and meeting support

MTIAC On-line Services

This is a collection of user-accessible databases and information files. It is available to MTIAC subscribers. It is directly accessible or can be accessed through an MTIAC information specialist. Included are:

- *MTIAC Manufacturing Database* — This database contains more than 10,000 references to manufacturing technology. Coverage includes materials from all over the world. This database resides on the Defense Technical Information Center's (DTIC's) DROLS System. Direct access is available to all DTIC users. Access is also available through an MTIAC information specialist.

- *SIMON Database of ManTech Projects* — SIMON contains project descriptions of ongoing and completed ManTech projects. It is a subset of the management database developed by the Department of Defense to track ManTech projects. The MTIAC version of SIMON contains more than 1700 project summaries. Information in each summary includes a description of the problem, the proposed solution, funding agency, years funded, funding information and point-of-contact. Proprietary and

out-year funding information does not appear. Those qualified to access this file include contractors and individuals with export control clearance. MTIAC requires Center membership for direct SIMON access as part of MTIAC on-line services.

- *Directory of Manufacturing Research Centers* — This is the on-line version of the printed directory published by MTIAC. It is on an INGRES database and updated regularly.
- *Schedule of Contract Demonstrations* — This listing includes all scheduled ManTech project End-of-Contract Demonstrations. It includes the project title, data and point of contact.
- *MTAG and other announcements* — This listing includes ManTech events with relevant industry, trade and professional conferences and meetings.

Document Library

The MTIAC document library includes full text technical reports, journal articles, conference papers and other material cited in the MTIAC Manufacturing Database. This collection contains more than 10,000 reports in hard copy and microfiche.

Technical Library

This library contains a large portion of the research collection of the Center.

Books — MTIAC has a substantial collection of books on advanced manufacturing technology. These include works on specific topics and general reference materials.

Conference proceedings — Proceedings contain much of the leading-edge technology. MTIAC actively acquires the latest proceedings from leading manufacturing conferences.

Journals — MTIAC subscribes to more than 100 journals in manufacturing and related fields.

Supplementary File — Some information collected by MTIAC is of short-term interest. This includes material that changes frequently, including product literature, press releases and newspaper clippings.

MTIAC Current Awareness Bulletin

MTIAC publishes a monthly newsletter entitled the MTIAC Current Awareness Bulletin (CAB). This newsletter covers all types of material of interest to the manufacturing community. MTIAC staff members collect, review and write most newsletter features.

Special Articles — The MTIAC CAB includes articles on a variety of manufacturing topics. In the past, issues have focused on a particular leading-edge technology, a manufacturing research center or an interesting manufacturing personality. Manufacturing professionals and industry analysts frequently author these special articles.

Manufacturing News — As a focal point for manufacturing technology, MTIAC received journals, newsletters, product literature, books, press releases, and other information relating to manufacturing. The MTIAC staff regularly reviews all this material for newsworthy items.

ManTech News — MTIAC constantly monitors the DoD Manufacturing Technology (ManTech) Program for interesting ongoing projects, funding information, and program trends.

Conference Reviews — To keep abreast of current manufacturing developments, MTIAC staff and associates attend both government and industry manufacturing related conferences and expositions. Staff observations and comments are described in CAB.

New Books — MTIAC receives many manufacturing related books. The CAB contains full descriptive information about books received. For books of special interest, a staff member or outside specialist will provide a review.

Government Reports — MTIAC monitors government publication sources for reports of interest to the manufacturing community. These reports come from offices as varied as the Office of Technology Assessment, Department of Commerce, General Accounting Office and Office of the Secretary of Defense.

Industry Reports — MTIAC reviews reports on the status of manufacturing industries, economic analyses, competitiveness assessments, and industrial base status. A variety of private organizations publish reports of interest to MTIAC readers.

Meetings and Conferences — MTIAC announces meetings of special interest, especially to the DoD ManTech community. These include conferences, exhibitions, symposia, and workshops.

End-of-Contract Demonstrations — MTIAC publishes an end-of-contract demonstration list for ManTech projects. This listing includes the date, point of contact, DoD affiliation and phone number.

Unique Personnel Expertise

Technical Inquiries
(312) 567-4732

Database/Library
(312) 567-4731

General Information
(312) 567-4730

Department of Defense

Metal Matrix Composites Information Analysis Center

Lab Description

The Metal Matrix Composites Information Analysis Center (MMCIAC) is sponsored by the DoD and serves as the DoD's central source of engineering and technical data, and research and development information on Metal Matrix Composites. Its technical scope includes all scientific and technical information aspects of the metal matrix composites (MMC) advanced materials technological field necessary for DoD basic and applied research in support of air, ocean, ground, and space related applications. The technical subject areas covered include all data and information on continuously and discontinuously reinforced MMC, laminates, and hybrid composites that contain MMC, applied to Defense systems and hardware.

Metal Matrix Composites Information Analysis Center
MMCIAC/CINDAS
Purdue University
2595 Yeager Road
West Lafayette, IN 47906-1398
Dr. C. Y. Ho, Director
Dr. Harvey M. Berkowitz, Assistant Director
Mr. Theodore J. Muha, Project Leader
Mr. James F. Chaney, Assistant Director for Inquiry and User Support Services
Phone: (317) 494-9393
FAX: (317) 496-1175
E-mail: mmca@ecn.purdue.edu

Organizational Structure

MMCIAC is a Department of Defense Information Analysis Center operated by the Center for Information and Numerical Data Analysis and Synthesis (CINDAS) of Purdue University for the DoD. MMCIAC is under the sponsorship of the Office of the Director of Defense Research and Engineering (Research and Advanced Technology), Mr. Jerome Persh, and under the management of the Defense Technical Information Center (DTIC), Dr. Forrest R. Frank.

Unique Equipment, Facilities or Services

MMCIAC services include responses to technical and bibliographic enquiries, production of handbooks, databooks, state-of-the-art reports, critical reviews, technology assessments, and newsletters, and performance of special technical area tasks. They are provided to eligible users at low cost, and often at no cost.

Specific subject areas covered include MMC properties; key R&D concepts, results, and trends; fabrication, processing, and applications; processing equipment; measurement, testing, and quality control; test equipment and evaluation methods; corrosion/deterioration detection, prevention and control, and other environmental effects on MMC and systems; sources, suppliers, and specifications for MMC of concern to the DoD; operational serviceability and repair; MMC component design criteria; MMC industrial subsystem and system applications; theoretical performance computations; and assessment of international R&D technology to determine its impact on MMC.

Services cover the following materials and properties:

Materials

- Metal matrix composites (e.g., graphite/aluminum, boron/aluminum, silicon carbide/aluminum, silicon carbide/titanium aluminide, silicon carbide/titanium

aluminide, titanium diboride/ nickel aluminide, and graphite/magnesium)
- Matrix materials (e.g., aluminum, magnesium, copper, beryllium, titanium, nickel, lead, and intermetallic compounds)
- Continuous and discontinuous reinforcements (e.g., fibers, wires, filaments, whiskers, and particulates)
- Reinforcement and/or fiber materials (e.g., graphite, alumina, boron, silicon carbide, silicon nitride, and titanium diboride).

Properties
-Mechanical
-Thermal
-Physical
-Electrical
-Chemical
-Wear
-Corrosional
-Dynamic

Department of Defense

Metals Information Analysis Center

Metals Information Analysis Center
CINDAS/Purdue University
2595 Yeager Road
West Lafayette, IN 47906-1398
Dr. C. Y. Ho, Director
Dr. Pramod D. Desai, Assistant Director
Mr. James F. Chaney, Assistant Director for Inquiry and User Support Services
Phone: (317) 494-9393
FAX: (317) 496-1175

Lab Description

The Metals Information Analysis Center (MIAC) serves as the DoD's central source of engineering and technical data and research and development information on monolithic metals, metal alloys, intermetallic compounds, and coatings utilized in Defense systems and hardware. Data and information on metal joints, welds, etc. are also covered. Emphasis is placed on those metals, alloys, intermetallic compounds, and coatings used in structural applications and/or stringent environments.

Subject areas covered include metals properties (especially mechanical properties as a function of temperature and environmental conditions); latest research and development concepts, results, and trends; applications and processing of metals; processing equipment; measurement and testing of metals; test methods; quality control related to metals; corrosion/deterioration detection; prevention and control, and other environmental effects on metals and systems; producers, suppliers, and specifications for metals of concern to the DoD.

Organizational Structure

MIAC is a Department of Defense Information Analysis Center operated by the Center for Information and Numerical Data Analysis and Synthesis (CINDAS) of Purdue University for the DoD. MIAC is under the sponsorship of the Office of the Director of Defense Research and Engineering (Research and Advanced Technology), Mr. Jerome Persh, and under the management of the Defense Technical Information Center (DTIC), Dr. Forrest R. Frank.

Unique Equipment, Facilities or Services

MIAC prepares various products which include handbooks, databooks, state-of-the-art reports, critical reviews, technology assessments, a quarterly newsletter, user's guide, etc.

MIAC offers a variety of services such as responding to technical and bibliographic inquiries, providing advice, consultation, and assistance, and performing technical area tasks. MIAC maintains a computerized metals bibliographic/literature database as part of Defense Technical Information Center's (DTIC) Defense RDT&E On-line System (DROLS). It is also developing a numerical/technical database on metals properties. MIAC also conducts, support, and/or participates in conferences, symposia, and workshops.

Products and Services

Available to all sectors of government and industry, the Center's principal products and services include:

- Technical inquiries and technical area tasks
- Bibliographic inquiries
- Technical advice, consultation and assistance
- State of the art reports, databooks and handbooks
- Technology assessments/ critical reviews
- Summaries of important developments in metals technology
- Metals information databases
- Special studies tailored to specific areas of metals technology

- Current awareness
- Organization, administration and publication of technical conferences/symposia proceedings

Technical Area Tasks

Utilizing the information and technical resources of MIAC technical staff, technical area tasks are undertaken for government agencies or their contractors to provide timely responses to the unique needs of MIAC users. Costs for these services are handled as special task orders through the basic MIAC contract or on separate contracts. Among the technical area tasks to be undertaken are:

- In-depth review and analysis of technical literature in highly specified areas
- Development of data for specialized applications of materials
- Comparisons of foreign and domestic technologies
- Technical assistance in materials applications
- Review of materials standards/specifications
- Development of computer-based information systems and databanks

Technical and Bibliographic Inquiries

Inquiries, requests for literature searches, and special technical requirements should be addressed to MIAC, by letter, telephone, or by fax. A qualified specialist is assigned to each inquiry to provide a personal, immediate response by phone or correspondence. All inquiries and requests for technical assistance are handled in confidence. By special arrangements with the laboratories at Purdue University, MIAC has the capability to perform experimental work on mechanical and thermophysical properties of metals. Costs are quoted in advance, and payment may be made via a purchase order, through a technical assistance agreement with MIAC, or, in special cases, by separate contract. Inquiries from Department of Defense Agencies can be handled by the use of a Military Interdepartmental Purchase Request (MIPR) through the basic MIAC contract. Please contact MIAC for further information.

Publications

Publications, such as state-of-the-art reports, handbooks, databooks, and conference proceedings are being produced in response to current needs of the technical community. Those published from 1971 to 1990 by MIAC's predecessor (MCIC) are currently available through MIAC.

For a complete list of publications available through MIAC, contact MIAC directly. Orders for publications should be sent to MIAC; orders may be prepaid (check or money order payable to Purdue University) or may be invoiced upon delivery; overseas orders and orders from booksellers require prepayment. (All deliveries within Indiana are subject to applicable sales tax unless exempt.)

Current Awareness Service

The "Current Awareness" activities of MIAC serve to alert users, on a timely basis, to significant technological developments. The principal vehicle for this function is the *MIAC Newsletter*, a quarterly publication which

- Summarizes significant developments in technology related to
  - -monolithic metals
  - -high strength steels
  - -superalloys
  - -light metals
  - -metals specifications
  - -metal joints
  - -applications
  - -processing
  - -fabrication
  - -quality control
  - -coatings
  - -welds
  - -mechanical properties
  - -thermophysical properties
  - -corrosion
  - -environmental effects
  - -test methods
- Presents timely and pertinent information on technical meetings, R&D contract awards, and new technical literature.
- Summarizes and highlights technical topics of interest.
- Announces new MIAC publications and summarizes MIAC activities.

The *MIAC Newsletter* is available, without charge, to qualified subscribers located in the United States. Written requests for the *MIAC Newsletter* should be submitted to MIAC.

Department of Defense

Naval Surface Warfare Center, Crane Division

Lab Description

The laboratory's mission is to provide quality and responsive engineering, technical and material support to the Fleet for combat subsystems, equipment and components; microelectric technology, microwave components, electronic warfare, acoustic sensors test, electrochemical power systems, conventional ammunition engineering, pyrotechnics, small arms, and electronic module test and repair.

Naval Surface Warfare Center
Crane Division
Attn: Code PM 1
Crane, IN 47522-5001
Mr. Dave Fisher
Phone: (812) 854-3667
FAX: (813) 854-1767

Organizational Structure

NWSC has nine centers of excellence: microelectronic technology, microwave components, acoustic sensors test, electronic warfare, electronic module test and repair, conventional ammunition engineering, pyrotechnics, and small arms.

Individual Lab Descriptions

Crane is one of ten Ordnance Navy Industrial Funded activities which reports to the Weapons and Combat Systems Directorate (SEA-06) of the Naval Sea Systems Command. Since 1967, Crane has operated as a Navy Industrial Funded Activity. Under this concept, Crane receives no appropriated funding for its operation. Their existence is determined entirely by their ability to provide services and unique capabilities and secure customers in the marketplace. Crane's competition comes from both the public and private sectors. Performance determines continued business.

Unique Equipment, Facilities or Services

Microelectronic Technology

NWSC Crane has some of the most comprehensive failure analysis and material analysis facilities in the world. Some examples of these capabilities are:

- The linear accelerator which provides pulsed gamma radiation with a dose rate of up to $1X10^{13}$ rads (si/sec) and 25 channels of data acquisition. This system provides the highest dose rate within DOD. This capability is used for design verification and transition to production of radiation hardened components intended for use in strategic systems. In addition, the capability is used to evaluate production radiation hardened parts and to monitor production processes used to manufacture those parts.
- Thermal management expertise is provided to assure high reliability of BSY-1 and BSY-2 systems. The thermal imaging system is used to analyze contractor's electronics cabinets and circuit cards for BSY-1 and BSY-2.
- A scanning auger capable of determining surface composition and elemental distribution in solid materials containing elements with an atomic number greater than 3 in concentration greater than 1%. This capability is used for electronic and ordnance component construction process and failure analysis.

Microwave Technology

More than one hundred types of radar and electronic countermeasures microwave components are tested, repaired and engineered in the state-of-the-art microwave component facility.

- The vacuum pumping station is a six-port vacuum processing station used for Traveling Wave Tube (TWT) and microwave tube repair. The TWT is an integral part of

electronic countermeasures and radar systems.
- The laser welder is used to weld solid state packages in refractory metals. This device is used in the SPS-40 radar system solid state transmitter.
- The Aegis TWT test set is a state-of-the-art microwave test set for quality assurance, production lot, and Fleet return testing and engineering evaluation of the AN/SPY-1 Radar TWT.

This capability is used for specification development, design evaluation, product evaluation, construction analysis, and failure analysis.

Acoustic Sensors Test

Crane operates a complex of hydroacoustic test facilities to measure performance of acoustic products including sonar transducers and hydrophones, sonobuoys, acoustic countermeasure devices, hull coatings, and torpedo acoustic guidance systems.

- The Dugger Lake Test Facility is a controlled-access lake facility with a depth of 100 feet for free field hydro-acoustic measurements of transducers and hydrophones. It incorporates a limited tow test capability for evaluating self-generated noise and very low frequency detection capability of sonobuoy devices.
- The extraneous noise test facility consists of 65 pressure tanks of various sizes for evaluation of self-noise of submarine hydrophones and transducers resulting from dynamic pressure changes. Special capabilities have been developed in the areas of quiet pressurization systems, large scale automated data acquisition, spectral analysis, false event discrimination, and failure analysis to measure energy and frequency of noise signatures.
- The Acoustic Tank Facility (ATF-I) allows acoustic measurements at simulated depths to 3400 feet over a wide range of ocean temperatures. New larger tanks (ATF-II) are installed which increase pressure capability to a depth of over one mile and expand low frequency capability down to 900 hz.

This capability is used to proof in-house and commercial designs, evaluate and accept commercial products, and evaluate in-house limited production supplied to the Fleet or used for procurement documentation development.

Electronic Warfare

NWSC provides comprehensive engineering, logistics and maintenance/repair support for the ALQ-99 Airborne Countermeasures System and SLQ-32 Shipboard Countermeasures System. Specialized repair and test capabilities include:

- The ALQ-99 Pod Repair and Refurbishment Program provides a universal platform for operation with all configured aircraft and equipment using the ALQ-99 Electronic Countermeasures System. In addition, reliability and maintainability improvements are being incorporated to extend the Pod life cycle and reduce operational costs.
- The Automated Receiver Test Station is an NWSC designed, developed, and built test station that offers test and fault isolation capabilities for surveillance receivers utilized in the ALQ-99 Electronic Countermeasures System.
- The Armament Control Unit (ACU) Test Station is part of the computer system test console and is used for test and repair of the ACU used in the ASQ-155 Ballistics Computer System. This test station is a "hot bench" tester which simulates aircraft armament wiring to facilitate fault isolation, repair and verification of the ACU.
- NWSC performs comprehensive repair, alignment and calibration on the SLQ-32 Countermeasures System and has designed and built testers that are being supplied to the Fleet for test and repair of the SLQ-32 System.

Electronic Module Test & Repair

NSWC Crane has complete capability to design, develop, manufacture, and test electronic circuit cards including the newest ceramic material and surface mount component technologies. Examples shown here include:

- A state-of-the-art circuit card test facility and equipment providing capability to design, develop, test, evaluate, and repair complex circuit card

assemblies and components.
- Testing equipment used to test, align, and repair a range detector module used in the MK86 Gun Fire Control System.
- A thick film circuit card manufacturing facility which includes copper thick film on ceramic substrate circuit board prototyping capability. This is the only such facility within the Navy.

This capability is used to prototype designs during transition to production, prove out design packages, test and evaluate commercial products, and manufacture limited quantities where quick turnaround is required or procurement documentation does not exist.

Electrochemical Power Systems

The Center provides design, acquisition, test, evaluation, surveillance, standardization, and system safety support for all types of Electrochemical Power Systems, including primary, rechargeable, and reserve batteries. The Center also provides support for test and evaluation of related equipment, including chargers, inverters, and discharge units. Specialized test facilities and equipment include:

- Complete facilities for teardown, wet chemical analysis, and spectroscopic analysis of battery materials for all electrochemistries.
- Computer controlled, state-of-the-art facilities for test and evaluation of all sizes and types of batteries, including FBM batteries and high energy (lithium) batteries.
- A new X-ray photoelectron spectrometer for identification of battery component surface layer elements and molecules. This system has the unique feature of permitting very large sample sizes, including entire battery electrodes.

Conventional Ammunition Engineering

Conventional ammunition support includes development, prototyping, functional, and non-destructive testing of demolition and Fleet Ballistic Missile ordnance devices. Examples of specialized test facilities and equipment located at NWSC Crane include:

- An 85-acre outdoor test facility for functional testing of in-service and developmental pyrotechnic and ordnance components.
- The SSPO Ordnance Test Facility which supports functional, quality, reliability, and safety evaluation of ordnance subsystems and related components for Polaris, Poseidon, Trident I and Trident II Missiles.
- Facilities also include prototyping, low rate initial production, teardown, and physical and chemical analysis capabilities.

These capabilities combined with the material analysis capabilities, are also essential to determination of safe, environmentally sound, demilitarization and disposal techniques for ordnance items.

Pyrotechnics

Special ordnance support includes development, prototyping, functional, and non-destructive testing of pyrotechnic devices. Examples of specialized test facilities and equipment located at NWSC Crane include:

- An 85-acre outdoor test facility for functional testing of in-service and developmental pyrotechnic and ordnance components.
- The flare mix and test area where flare compounds are mixed and compressed for use in decoy and illuminating flares.
- A robotic or flare test used to measure spectral intensities from ultraviolet through infrared.

These capabilities are used to prototype, evaluate, and validate special ordnance item designs, determine their safety for use, measure their effectiveness, and monitor their production through sample evaluation.

Small Arms

The Center provides design, development, acquisition, test, and evaluation of small arms, weapons, night vision devices, laser range finders, laser markers, and individual combat equipment in support of special operations forces. Specialized test facilities and equipment include:

- A 1000-yard outdoor test range for pressure/velocity testing, accuracy evaluation, and functional firing of small arms and small arms ammunition. Scopes, laser devices, and 25mm gun systems are tested here also.
- A class 100,000 night vision clean room used to support test, evaluation, and repair of image intensifier tubes, lasers, and various electro-optic devices and chemical agent detectors.
- A unique new 100-meter underground test range for engineering development and evaluation of small arms weapons up to 25mm, which includes a controlled environment for ballistic testing of small arms ammunition and controlled illumination for test and evaluation of night vision devices and laser devices.

These facilities are used to support development, transition to production, and procurement of a wide variety of small arms weapons systems. The facilities also support in-house development and overhaul programs of small arms and night vision devices.

Microwave Components

More than one hundred types of radar and electronic countermeasures microwave components are tested, repaired and engineered in the state-of-the-art microwave facility.

- The vacuum pumping station is a six-port vacuum processing station used for Traveling Wave Tube (TWT) and microwave tube repair. The TWT is an integral part of electronic countermeasures and radar systems.
- The laser welder is used to weld solid state packages in refractory metals. This device is used in the SPS-40 radar system solid state transmitter.
- The AEGIS TWT test set is a state-of-the-art microwave test set for quality assurance, production lot, and Fleet return testing and engineering evaluation of the AN/SPY 1 Radar TWT.

This capability is used for specification development, design evaluation, product evaluation, construction analysis, and failure analysis.

Mechanical Devices

Provides overhaul, repair, and full life-cycle support for a broad range of mechanical devices, and major mechanical components for naval weapons systems. Components include regulators, hydraulic pumps, hydraulic power drives (train and elevation), control system valve blocks, buffers, recoil cylinders, fuse setter assemblies, bearing transmitters, and target destination transmitters.

The Louisville site provides full overhaul, repair, and test of the devices. The devices are tested utilizing special test equipment, including dynamometers, and other hydraulic, pneumatic, and electro/mechanical test equipment.

Engineering services available include design and analysis. Prototyping and pilot production of improved devices is provided by the Louisville site's extensive manufacturing and machining capabilities.

Metal Parts Fabrication

Mechanical Part Fabrication and machining capability for small parts to large weldments. Complete capability for machining, plating, striping, heat treating, coating, and painting. Precision of machining to 1/10,000ths of an inch. Surface treatment capability includes a state-of-the-art plating facility and paint booths that will hold large gun mounts. Current products include: rocket motors, warheads, missile launcher stands, ammunition lockers, small machined parts, gun barrels, fiberglass gun covers, machine gun mounts, and mine anchors.

Unique Personnel Expertise

More than 1200 scientists, engineers (electrical, mechanical, chemical) and technicians are employed at Crane. In addition, Crane employs more than 1800 trades/crafts people who perform machine tool work, ammunition explosive and toxic materials functions,

electrical equipment installation and maintenance, and metal processing.

CRADAs

- Electronic Manufacturing Productivity Facility (EMPF) - Partners are the Naval Surface Warfare Center, Crane Division; Naval Air Warfare Center, Aircraft Division, Indianapolis, and Indiana University-Purdue University Indianapolis. Together they provide a transfer of manufacturing technology, increase domestic productivity, conduct applied research projects to assist manufacturers, provide hands-on training to students, and conduct workshops and seminars that foster exchange of electronics manufacturing information.
- Federal Phone Technology - Partner with industry. Purpose is to provide holders for blasting caps.
- Products Data Exchange Using STEP (PDES), Inc. - Partner with industry. Purpose is for technical development of product engineering definition standards in digital format.
- Microlithics Corporation - Partner with industry. Purpose is jointly develop a method to address component obsolescence in Navy electronic equipment. The effort will pursue the development of universal Standard Electronic Modules.
- Productivity Center - Partner with private industry. Purpose is to allow private industry use of facilities, equipment, and resources of the Louisville naval industrial facility. Provide training in new manufacturing technologies and management techniques and serve as a test bed for technology application and transfer.

Consortium

- Mid-America Electric Vehicle Consortium - Headquartered at the EMPF, this consortium includes component suppliers, electric and gas utility companies, government agencies, universities and specialty technology companies from Indiana, Michigan, Wisconsin, California, Tennessee, Massachusetts, and North Carolina, which will combine resources to build and maintain a fleet of electric and hybrid electric vehicles for use in military and commercial environments.

Department of Defense

Naval Air Warfare Center, Aircraft Division, Indianapolis

Naval Air Warfare Center
Aircraft Division, Indianapolis
6000 E. 21st Street
Inadianapolis, IN 46219-2189
Mr. Larry Halbig
Phone: (317) 353-3838
FAX: (317) 353-3583

Lab Description

The Naval Air Warfare Center (NAWC), Aircraft Division, Indianapolis (formerly the Naval Avionics Center) is a leader in the manufacturing of advanced aviation electronics (avionics) for many of the finest systems in the Navy. Their full-spectrum, state-of-the-art activity provides the personnel, facilities, equipment, and technical expertise to pursue advanced avionic and electronic concepts for the Navy, as well as other Department of Defense and federal agencies.

As a member of the NAWC-AD, the Indianapolis facility teams with activities at Lakehurst, New Jersey; Patuxent River, Maryland; Trenton, New Jersey; and Warminster, Pennsylvania, to share their expertise and to better serve customer needs. NAWC Indianapolis contributes its expertise in the leadership areas of avionics systems, transition from development to production, advanced electronics manufacturing and support, and pilot/emergency manufacturing.

NAWC-AD Indianapolis fulfills its avionics manufacturing leadership responsibilities by introducing, maintaining and continuously improving capabilities in the areas of technology insertion, design engineering, fabrication, test and evaluation, facilities, logistics, and management. These essential capabilities are then applied to the programs/projects that are generated to serve the NAWC-AD Indianapolis customer.

Organizational Structure

The Indianapolis activity is comprised of four directorates: Avionics, Platforms, Anti-Submarine, and Weapons. The directorates provide centralized leadership for high-profile programs through the Plans and Programs Department, ensuring that a consistent long-range vision is maintained across the diverse programmatic operations.

Individual Lab Descriptions

Avionic Systems

The Indianapolis site is the "Center of Excellence" for systems engineering, technology management, and application in avionics. Its involvement in advanced concepts for avionics includes developing requirements, conducting analyses, and providing technology evaluations. It is instrumental in defining and evaluating avionics architecture for new and upgraded aircraft by providing extensive simulation, stimulation, and hot bench capabilities. Principal product areas include navigation/flight, communications, computers, electronic warfare, radar, telemetry, receiving, displays, and sensors.

Manufacturing Technology

NAWC-AD Indianapolis fulfills its avionics manufacturing leadership responsibilities by introducing, and continuously improving essential capabilities in the areas of technology insertion, design engineering, fabrication, test, facilities, logistics, and management. It introduces leading-edge technology in product design, manufacture, and quality assurance through the utilization of complex computer networks which combine computer aided design (CAD), computer aided manufacturing (CAM), and computer integrated manufacturing (CIM) functions. Specific manufacturing capabilities include CAD/CAM, reverse engineer-

ing, electronics assembly, cable and wire harness fabrication, printed circuit board fabrication, hybrid microelectronics fabrication, small parts machining, heat treatment, plating, welding, stereolithography, and Computer-Aided Acquisition and Logistics Support.

Unique Equipment, Facilities or Services

- Advanced Microelectronics Facility
- Rapid Acquisition of Manufactured Parts Facility
- Flexible Machining System
- Electronics Manufacturing Productivity Facility
- Digital Avionic Systems Laboratory
- Materials Laboratory
- Failure Analysis Laboratory
- Electro-Optics Laboratory

Patents for License

Optical Pattern Generation
(Patent Pending)

Higher Yield Method of Creating Greyscales
(Patent Pending)

MIL-STD-1553/1773 Convertor
(Patent Pending)

Machine Tool Oil/Coolant Separator
(Patent Pending)

List Chip CoProcessor
(Patent Pending)

All-Diamond IMPATT Diode
(Patent Pending)

Planetary Roller Friction Drive
(Patent Pending)

Matching Network for Sleeve Antennas
(Patent Pending)

T-Slot Sheave

CRADAs

NAWC Aircraft Division Indianapolis, NSWC Crane Division and Indiana University-Purdue University of Indianapolis (IUPUI) are united in a CRADA which is referred to as the Electronics Manufacturing Productivity Facility (EMPF). For further information regarding EMPF, please refer to the Facility's catalog listing.

Department of Defense

Supportability Investment Decision Analysis Center

Supportability Investment Decision Analysis Center
5100 Springfield Pike, Suite 311
Dayton, OH 45431-1231
Mr. Kevin Deal
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Fax: (513) 254-9575
Toll Free: (800) 547-4322
Bulletin Board System: (800) 537-4322

Lab Description

SIDAC is an Information Analysis Center operated by Battelle. SIDAC's mission is to acquire, improve and apply existing analysis methods, models, techniques, and enabling services for every aspect of weapon system supportability; and to vigorously assess and promote enhancements to the associated supportability investment decision processes.

Organizational Structure

SIDAC is an analysis center operated by Battelle in Dayton, Ohio. SIDAC is sponsored by the headquarters of Air Force Materiel Command and Wright Laboratory.

Unique Equipment, Facilities or Services

Bibliographic Database

The SIDAC database is composed of management information, analytic information, and reference information. The database provides retrieval capability using key-words and cross-references to sources of information needed by SIDAC users.

Computer Models and Data

SIDAC has a repository of models with the required documentation and access to input data. They can provide expert assistance for the following models:

- Aircraft Availability Model (AAM)
- All Mobile Tactical Air Force (AMTAF)
- Dynamic Multi-Echelon Technique for Recoverable Item Control (Dyna-Metric)
- Logistics Composite Model (LCOM)
- Logistics Support Costs (LSC)
- Methodology for Assessment of Reliability and Maintainability Goals and Investments (MARGI)
- Measure of Merit (MOM)
- Network Repair Level Analysis (NRLA)
- System/Costs Operational Performance Evaluation (SCOPE)
- Theater Simulation of Airbase Resources (TSAR)

SIDAC also has the capability to extract data and information from the following data systems:

- Automated Weapon System Master Plan (AWSMP)
- Depot Maintenance Management Information System (DMMIS)
- DTIC RDT&E On-Line System (DROLS)
- Reliability and Maintainability Management Information System (REMIS)
- Requirements Data Bank (RDB)
- Stock Control and Distribution System (SC&D)
- Weapon System Management Information System (WSMIS)
- Visibility and Management of Operating and Support Costs (VAMOSC)

Reference Library

The SIDAC reference library includes hard copy documents covering subjects within the supportability investment decision analysis scope. Documents from the Product Performance Agreement Center Library have also been included. More than 3000 documents are located at the SIDAC facility with an adjacent reading area. The full-time librarian is able to search the files of the Defense Technical Information Center and numerous other sources to meet user needs for information.

Current Awareness Program
SIDAC publishes monthly bulletins to keep their users apprised of the latest and most significant developments within the supportability investment decision analysis field. Individuals on the user list automatically receive information about SIDAC reports, software, new R&D programs, conferences, and other SIDAC-related developments.

Referral Service
SIDAC maintains a cross-reference system to direct users to other sources of data not contained in SIDAC, including individuals, government agencies, colleges or universities, commercial organizations, or professional societies.

Unique Personnel Expertise
The SIDAC core staff includes two logisticians, a librarian, a computer scientist, and the required administrative support to fulfill all the needs of their customers.

Department of Defense

Tank-Automotive Research, Development & Engineering Center (TARDEC)

Lab Description

TARDEC is a component of the United States Tank-Automotive Command and is the Department of Defense's lead agency for the ground mobility fleet. Its goal is to provide the most effective combat and tactical vehicles to the U.S. ground forces. TARDEC is one of three Cray supercomputer Army sites. The center's staff of more than 550 engineers and scientists manages the design, development and modification of tank-automotive equipment.

Army Tank-Automotive Research, Development and Engineering Center (TARDEC)
Attn: AMSTA-ZH
Warren, MI 48397-5000
Mr. Herbert Dobbs, Jr.
Phone: (313) 574-5436
Mr. Robert J. Watts
Phone: (313) 574-5270
FAX: (313) 574-6941
DSN: 786-5436
E-mail:
dobbsh%ccmail@tacom-emh1.army.mil

Individual Lab Descriptions

The National Automotive Center

During FY 1993, TARDEC has established the National Automotive Center (NAC). NAC's mission is to serve as the catalyst linking academia, industry, and government agencies in all aspects of automotive technology. Its focus is on research, development, manufacturing and education.

The NAC will implement and sustain a program through which the automotive industries, U.S. government laboratories, and academia pursue technology and manufacturing research and development projects. The four main functions of the NAC are to:

- *Foster Automotive Basic Research* — The NAC will act as a critical mechanism to identify current and focus future basic automotive research from within academia and government. The focus automotive substance and relevance of this basic research provides a key building block for future dual use commercial and defense applications. The NAC, working in conjunction with the Army Research Office (ARO), the Army Research Laboratory (ARL), and other government laboratories, will initially define a benchmark "state-of-the-art" condition of current worldwide automotive research. This current research benchmark will provide a technical foundation upon which future automotive research advances will be built. Definition and prioritization of future automotive research needs will be performed by an independent steering committee of government/academic industry representatives. The NAC will act as a focused gateway of automotive research efforts from all available sources such as universities, government laboratories, and industry's advanced technology consortia.

In addition to the automotive research activities discussed above, it is anticipated that new automotive research initiatives will be established to fill significant technological voids. These new automotive research initiatives will be closely monitored and evalution of the complete tank traversing specified courses at a remote test site. Permits the motions of a particular run over

knowledgeable of the needs and capabilities of the government and automotive industry, an information center will be established to facilitate information gathering and analysis where technical information will be consolidated and/or furnished to government and industry users. With worldwide information more readily available, the NAC will offer technical and business analyses to determine the most viable collaborative opportunities. Cooperative agreements will be developed to focus on the collaboration of R&D efforts, the two-way transfer of advanced technologies, and the mutual leveraging of capabilities and facilities.

• *Facilitate Manufacturing Development* — In order to facilitate the development of manufacturing technologies, the NAC will foster the study and development of agile manufacturing capabilities to integrate with the various manufacturing technologies currently being used in the automotive industry. This advancement will support the development of a defense conversion plan to establish a manufacturing contingency in the event of global war. Through these efforts, agile manufacturing capabilities will be established throughout industry, enabling companies to more efficiently utilize their resources.

• *Foster Professional Development* — The NAC will provide a means of developing individuals within the military, federal service, and the community on historical, current and future technological advances in ground vehicle systems. Its purpose is to provide organized learning experiences which will increase the possibility of improved job performance and individual/organizational/community growth. These learning experiences will facilitate the education, training, and development of a work-force ready for the 21st century.

Organizational Expertise and Special Facilities

• Ground vehicle signatures; millimeter wave, infrared, visual, magnetic, seismic and acoustic; and simulation of ground vehicle signature environments
• Psychophysical modeling of human perception
• Analysis, computer modeling and physical simulation of ground vehicle ride dynamics, stability and safety; including commercial trucking
• Ground vehicle mobility analysis for terrains worldwide
• Dynamic analysis and computer modeling of vehicle structures
• Thermal stress analysis modeling of engine components
• Automatic fire detection and extinguishing
• Teleoperation and autonomous robotic systems for off-road and highway vehicles guidance
• Precision welding of large armor structures
• Large automotive composite structures applications, design, manufacture, and repair
• Virtual reality prototyping of vehicle systems
• High-speed tracked-vehicle suspension, steering, stability, and dynamics
• Heavy off-road ground vehicle propulsion system integration, including cooling, air filtration and electric drive systems
• Infrared imaging of high-speed events
• Concept development, design and prototype fabrication of light through heavy class special purpose ground vehicles for on-road or off-road duties
• Advanced design and manufacturing processes, incorporating automated/flexible manufacturing planning, and computer-aided design
• Integration of ground vehicle control systems for electric power, control and computer data (Vetronics)

Special Facilities

• Cray 2 Supercomputer - Used for structural analysis and vehicle stability and dynamics studies.
• 20-ton Capacity Ride Motion Simulator - A computer-controlled 6-axis (3 linear, 3 rotational), hydraulically-driven simulator, capable of mounting an M1 tank turret, and moving the turret in a computer-controlled simulation of the complete tank traversing specified courses at a remote test site. Permits the motions of a particular run over a test course to be exactly repeated, which is unattainable with actual driving.

• Laminate Object Modeling (LOM) System - A system for rapidly constructing model or light-duty prototype mechanical parts directly from Computer-Aided Design (CAD) computer files. The system builds objects as large as 14.5"X10"X14" from progressively applied layers of paper or plastic sheet.
• Extreme Resolution Stereoscopic Display - A boom-mounted stereoscopic vision system, for visualizing in 3 dimensions, any computer-generated scene from any desired position and angle. Permits realistic interior and exterior views of new vehicles, with no physical limitations on the operator's position. Used to rapidly evaluate man-machine interfaces and to resolve potential equipment location conflicts before any physical prototypes are made. A vital element in virtual prototyping operations.
• 1500 Horsepower Powertrain Test - Facilities for testing complete engine, transmission, cooling, aircleaner and driveline systems for both wheeled and tracked propulsion, up to 1500 horsepower. Includes capability to test tracked vehicle steering system performance. Equipment can be tested either mounted in the vehicle, or removed. Permits full-load cooling tests on complete vehicles up to 1500 horsepower, in simulated environments up to 120 degrees Fahrenheit, with solar radiation and winds.
• Mechanical Component Test Facilities - Vehicle braking and hydraulic systems testing
• Vehicle Crew Station Simulation Facility - A three-place advanced vehicle crew-station test system, equipped with advanced crew displays and controls, and computerized scene generation. Used to research new control methods, crew configurations and sizes, and advanced vision systems for vehicle crews.
• Armor Test Lab - An indoor firing range facility, equipped with two closed-tube firing systems. Permits firing projectiles up to 30 millimeters in diameter within closed tubes, against armor material test samples. Used to evaluate the armor protection of lightly armored vehicles.
• Vehicle Fabrication Area - A prototype fabrication and low-rate production facility capable of designing and fabricating a complete tank, or any other off-road or highway special-purpose ground vehicle.
• Vehicle Test Track - A 1-1/2 mile test track suitable for heavy vehicles, including tanks.

Patents for License

Trailer/Trac Light System
K. R. Lapensee
11/28/89
Patent No. 4,884,032

Anti-Backlash Mechanism
R. Smith
12/12/89
Patent No. 4,885,950

Hybrid Lens for Shearographic Carrier Fringe Generation
D. Templeton
1/2/90
Patent No. 4,890,914

Fire Sup Bottle Circuti Broker Cable
Wittbrodt and Simkovitz
1/16/93
Patent No. 4,893,680

Electronic Fuel Injector
C. McCoy, et.al.
1/16/90
Patent No. 4,893,599

Manual Override for Electronically Controlled Auto Trans
Erwin F'Gepper
3/20/90
Patent No. 4,909,775

Simplified Mine Roller Assemble
Israel Grinwald
3/20/90
Patent No. 4,909,128

Bypass Emergency Electrical Fuel System for M1 Tank
Curtis McCoy, et.al.
4/30/90
Patent No. 4,913,110

Two Lever Control Box
Curtis McCoy, et.al.
4/17/90
Patent No. 4,916,983

Adjustable Foot
Andrew J. Skully
5/1/90
Patent No. 4,921,269

Adjustable Height Stairway
Kyle J. Nebel
2/3/93
Patent No. 5,189,854

Lower Travel Stop
David Bushell, et.al.
6/26/90
Patent No. 4,936,189

Modular Armor Structure
Server Tasdemiroglu
9/18/90
Patent No. 4,957,034

High Speed Imaging System
Steven Shepard
11/13/90
Patent No. 4,970,597

Cable Harness Wire Replacement Tube
John Monroe
2/12/91
Patent No. 4,992,626

Lock Mechanism
Robert Culling
3/5/91
Patent No. 4,997,218

High Pressure Gas Actuated Reactive Armor
Rene Gonzalez
6/25/91
Patent No. 5,025,707

Circuit Breaker Pull/Lock Device
Robert Brucksh
8/13/91
Patent No. 5,039,829

Roll-Up (Drive Up Jack Stand)
Joseph Warner
8/13/91
Patent No. 5,039,070

Security Drain Plug
John Korpi
10/22/91
Patent No. 5,058,058

Vehicle Voltage Reducer
John Monroe
1/7/92
Patent No. 5,079,437

Gun Mount Exerciser
Michael Audino, et.al.
1/7/92
Patent No. 5,078,045

Router Pen Attachment
A. Stormer
1/14/92
Patent No. 5,080,539

Mine Flow Blade
Donald Kendall
3/24/92
Patent No. 5,097,911

Composite Projectile
Wayne Wirgau
4/21/92
Patent No. 5,105,713

Improved Tow Bar Assemble
Roger Smith
5/12/92
Patent No. 5,112,074

Flotation Device for a Bradley
Curtis McCoy, et. al.
5/19/92
Patent No. 5,113,779

Adjustable Size Ammo Box Retainer
Al Loew, D. Henning
7/28/92
Patent No. 5,113,489

Hardware Interface for High Speed Video Imaging
S. Shepard, et.al.
8/4/92
Patent No. 5,136,383

Improved Personal Heater
William Chu
8/11/92
Patent No. 5,137,445

Adjustable Size Ammunition Box Retainer
D. Henning, A. Loew
8/18/92
Patent No. 5,139,186

Composite Roadwheel with Integral Wearplate
John Korpi
8/25/92
Patent No. 5,141,299

HMMWV Lift Kit
Jeff Parks
9/1/92
Patent No. 5,143,326

Roll Up Jack Stand
Joseph Warner
10/6/92
Patent No. 5,152,505

Rollup Jackstand
Joseph Warner
10/6/92
Patent No. 5,152,484

Compound Turbbuckle for Precision ADJ of a Head Support
Bruce Amrein, et.al.
11/24/92
Patent No. 5,165,137

Dual Acting Brake Actuator
Kyle Nebel
12/8/92
Patent No. 5,168,769

Infinitely Variable Transmission
Richard Line
1/19/92
Patent No. 5,179,865

Ammunition Compartment Blast Door Lock
Donald Kendall
4/13/93
Patent No. 5,201,556

Roll Up Jack
Joseph G. Warner
7/20/93
Patent No. 5,288,651

Traction Boot for Tires
Joseph G. Warner
8/10/93
Patent No. 5,234,041

Shock Absorber Bracket and Pin
Joseph Warner, William Jones
9/7/93
Patent No. 5,242,238

Portable In-Field Engine Tester
Jeff Parks, Joseph Brown
9/14/93
Patent No. 5,243,851

Walking Beam Track Tension Device
Donald Kendall
9/21/93
Patent No. 5,246,246

Expandable Enclosure
Syed M. Hussaini
9/28/93
Patent No. 5,248,180

Department of Defense

U.S. Army Construction Engineering Research Labs

Lab Description

The U.S. Army Construction Engineering Research Laboratories (USACERL) are the lead laboratories in the Army for base support. USACERL's research is directed towards increasing the Army's ability to more efficiently construct, operate and maintain its Army installations and ensure environmental quality and safety at a reduced life-cycle cost. USACERL works closely with its Army customers to ensure its research produces responsive products that are delivered in a timely manner.

U.S. Army Construction Engineering Research Laboratories (USACERL)
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P.O. Box 9005
Champaign, IL 61826-9005
Mr. Robert Gorham
Phone: (217) 373-6789
(800) USA-CERL (outside IL)
(800) 252-7122 (within IL)

Organizational Structure

Excellent facilities support the Army's training readiness, mobilization and sustainability missions. The three organizations within USACERL—the Infrastructure Laboratory, the Environmental Sustainment Laboratory and the Technical Assistance Center—work to develop quality products and services and to help customers to implement new technologies.

Individual Lab Descriptions

Infrastructure Laboratory

The Infrastructure Laboratory is divided into three divisions: the Facility Management Division, the Engineering and Materials Division and the Energy and Utility Systems Division.

The Facility Management Division conducts research on construction management systems, computer-aided design applied project management, facility space planning and management, computer based instruction for engineering, computer technology and knowledge base design, installation master planning and facility life-cycle analysis methods, and the automation and simulation of theater of operations construction missions.

The Engineering and Materials Division conducts research on innovative engineering practices and materials used in the construction, maintenance, and repair of Army facilities. Expert systems are being developed in support of quality control and quality assurance activities. Innovative procedures are being examined for monitoring and preventing the corrosion of buried or submerged steel structures. Research is also conducted on construction techniques and coatings for shielding against electromagnetic pulse. This division also performs seismic engineering and structural dynamics research for Army facilities.

The Energy and Utility Systems Division is responsible for providing energy systems technology and energy management methods for the design, construction, operation and maintenance of Army facilities. Research is conducted on central heat plant modernization, air pollution control equipment, alternate energy sources, electrical generation and supply, thermal energy supply and distribution, incineration and heat recovery, energy analysis, design and management techniques, acceptance testing, control systems, and system failure diagnostics.

Environmental Sustainment Laboratory
The Environmental Sustainment Laboratory is also divided into three divisions: the Environmental Natural Resources Division, the Pollution Prevention Division, and the Environmental Compliance Modeling and Simulation Division.

The Environmental Natural Resources Division conducts research on training area rehabilitation and management, including training requirements integration, land inventory and monitoring, land management and scheduling support, rehabilitation and maintenance, and environmental awareness indoctrination. In addition, research is conducted on noise source control, assessment, prediction, mitigation and management, protection of threatened and endangered species, collection, analysis, storage and retrieval of environmental resources information, and command-level environmental resource planning and analysis systems.

The Pollution Prevention Division's research areas include hazardous waste and pollution abatement and management systems, air pollution analysis and standards, water supply, treatment and distribution, wastewater collection and treatment, solid waste management, and industrial operations pollution control.

The Environmental Compliance Modeling and Simulation Division conducts research on environmental auditing, systems for compliance, land resources analysis, training area management, land condition trend analysis methodologies and systems, base closing and realignment, and scientific environmental management.

Technical Assistance Center
The Technical Assistance Center provides support for technologies that are ready for field adoption until such support is made available by the proponent of the technology. They work with the researchers to prepare documentation required or the transfer of support to the organization designated by the proponent. The Center provides support for technology adoption, enhancement, and update, including technology implementation assistance and guidance. They assist researchers and proponents in supporting training courses and workshops supporting technology transfer. The Center also acts as a consultant between DOD organizations and other Federal and State agencies when needed.

Unique Equipment, Facilities or Services
USACERL has unique equipment available at the laboratory sites, including

- 12 ft-sq MTS Biaxial Shock Test Machine, 0-600Hz, 450 KIP horizontal, 810 KIP vertical,
- Full capacity metallurgy lab,
- HVAC experimental facility,
- 1,000,000 pound MTS tension/compression testing machine,
- Ion-plating system for corrosion-resistant coatings,
- Scanning electron microscope with EDX capability,
- Bounded wave electromagnetic pulse simulator,
- Instrumented impact testing machines, up to 2000 pounds,
- Structural load floor,
- Mobile acoustics laboratory,
- Mobile chemistry laboratory,
- Sound propagation field station,
- Impulse noise mitigation facility.

Patents for License
Optoelectronic Weld Evaluation Systems
Frank W. Kearney
Patent No. 4,448,354
5/1/84

Prefabricated Vehicle Maintenance Apparatus
Roger L. Brauer
Patent No. 4,352,322
10/6/82

Weld Quality Monitor
Frank W. Kearney
Patent No. 4,375,028
2/22/83

Apparatus for Determining Break Locations in Fencing
Paul H. Nieleen
Patent No. 4,450,434
5/22/84

Pipe Corrosion Monitor
John M. Bukowski
Patent No. 4,611,175
9/9/86

Apparatus for Determining Break Locations in Fencing
Ray G. McCormack
Patent No. 4,450,434
5/22/84

Ceramic Anodes for Corrosion Protection
Ashok Kumar
Patent No. 4,445,989
5/1/84

Pipe Corrosion Monitor
Ellen G. Sagan
Patent No. 4,611,175
9/9/86

Optoelectronic Weld Travel Speed Sensor
Frank W. Kearney
Patent No. 4,399,346
8/16/83

Hand-held Washing Device
Joseph E. Matherly
Patent No. 4,646,870
3/3/87

Pipe Corrosion Monitor
Ashok Kumar
Patent No. 4,611,175
9/9/86

Ceramic Anodes for Corrosion Protection
Jon L. Helgeland
Patent No. 4,445,989
5/1/84

Microphone Droop and Sensitivity Measurement Device
Alan B. Hunt
Patent No. 4,347,410
8/31/82

Hand-held Washing Device
Leslie J. Benson
Patent No. 4,646,970
3/3/87

Optical Fire Detection System Responsive to Spectral Content and Flicker Frequency
Ray G. McCormack
Patent No. 4,633,834
8/6/86

Distance Measuring System
Ray G. McCormack
Patent No. 4,397,548
8/9/83

Ceramic Coated Strip Anode for Cathodic Protection
Ashok Kumar
Patent No. 4,946,570
8/7/90

Electrical Conduit Defect Location
Paul H. Nielsen
Patent No. 4,471,294
9/11/ 84

Department of Defense

Wright Laboratory

Lab Description

Wright Laboratory is one of the four Air Force Super Laboratories.

Organizational Structure

The laboratory is divided into eleven directorates (seven technical): Aero Propulsion and Power, Armament, Flight Dynamics, Avionics, Solid State Electronics, Materials, and Manufacturing Technology. Each of the technical directorates have specialized individual facilities available for use.

Wright Laboratory
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Wright-Patterson AFB, OH 45433-7562
Mr. Dick Jones
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Air Force Legal Services Agency
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Directorate Descriptions

Aero Propulsion and Power Directorate

The Aero Propulsion and Power Directorate focuses on air-breathing propulsion and aerospace power technology, which includes fuels and lubricants, turbine engines, and high performance/high Mach speed, air-breathing propulsion applications. Research into aerospace power systems up to the megawatt-class centers around electrochemical energy storage, hyperconducting generators, and power conditioning subsystems.

Armament Directorate

The Armament Directorate develops conventional armament technologies and integrates those into air-vehicle and other delivery platforms. The directorate provides conventional armament technology for four major thrusts which include advanced guidance, weapon flight mechanics, ordnance, and strategic flight.

Avionics Directorate

The Avionics Directorate conducts research and development activities in the fields of offensive sensors (e.g., radar, infrared search and track, forward looking infrared), weapon delivery systems, reconnaissance, electronic warfare, navigation, communications, and avionics integration. Engineers emphasize not only performance enhancement, but avionics reliability and affordability as well.

Flight Dynamics Directorate

The Flight Dynamics Directorate conducts the full spectrum of flight vehicle research. Primary areas of interest include aircraft structures, vehicle subsystems, (landing gear, transparencies, etc.), flight control and aeromechanics. In addition, this directorate develops and maintains a fleet of experimental test vehicles to demonstrate integrated technologies (e.g., avionics, flight control, propulsion) in an airborne environment. The Directorate is divided into five divisions: structures, flight control, aeromechanics, cockput integration, and vehicle subsystems.

Manufacturing Technology Directorate

The goal of the Manufacturing Technology (ManTech) program is to enhance productivity, increase quality, and reduce life cycle cost of weapon systems. Contractual projects are application oriented, designed to demonstrate, validate, and implement manufacturing processes for use by the aerospace industry and the Air Logistics Centers of the Air Force Materiel Command.

ManTech investments address high-payoff problem areas in all industry sectors producing and repairing weapon systems and support equipment for the Air Force. Problems addressed are generic in nature, applicable to virtually all manufacturers in any industry sector and to multiple weapon systems. Efforts address all levels of industry from large prime contractors to material and parts vendors as small as 20 person shops.

Materials Directorate

The Materials Directorate has led the aerospace industry in materials and processes research and development, and has provided vital support to the Air Force in selecting new materials and processes for systems and quick-reaction support to field organizations. The Directorate's mission is to plan and execute the U. S. Air Force program for materials and processes in the area of basic research, exploratory development, and advanced development; and to provide systems support to Air Force product centers and operating commands to solve system related problems and to transfer expertise in the areas of materials and processes. The Directorate's current focus is on thermal protection materials, metallic and nonmetallic structural electronic materials and laser-hardened materials.

Plans and Programs Directorate

The Plans and Programs Directorate manages system and subsystem level technology integration across all Wright Lab disciplines and includes technologies from other organizations. Manages key high emphasis multidisciplinary technology development. Responsible for the Wright Lab investment strategy process and technology transfer/ transition.

Solid State Electronics Directorate

The Solid State Electronics Directorate is responsible for electronic device research and development in the areas of microelectronics, microwaves and electro-optics. Research extends from fundamental semiconductor layer growth and device fabrication through integrated circuits. In the electro-optics area, lasers, detectors and integrated focal plane arrays are developed.

Unique Equipment, Facilities or Services

Aero Propulsion and Power Directorate

This directorate has 52 in-house facilities capable of conducting research in the following areas:

- airbreathing propulsion systems
- helicoptor rotor testing
- propeller testing
- aircraft electrical power systems
- optics
- plasma physics
- power semiconductor devices and materials evaluation
- thermionic energy conversion
- heat transfer
- batteries
- pulsed high voltage
- electrical power systems
- superconductivity
- advanced propulsion combustion
- water tunnels
- ramjet combustion
- subsonic and supersonic combustion
- combustion
- fuels
- fuel spray/advanced diagnostics
- bearings
- lubricants
- sea level engine stands
- turbine engines

Armament Directorate

This directorate has 102 in-house facilities capable of conducting research in the following areas:

- propulsion systems
- flight systems
- electrical power systems

- optics
- plasma physics
- thermionic energy
- heat transfer
- batteries
- superconductivity
- combustion (ramjet, subsonic, supersonic)
- fuels
- bearings
- lubricants
- turbine engines
- aeromechanics
- guidance
- munitions
- fabrication
- electromagnetic launchers/railguns

Avionics Directorate

This directorate has 68 in-house facilities capable of conducting research in the following areas:

- artificial intelligence
- crews systems integration
- embedded software
- communications (laser, satellite)
- avionics
- laboratory and flight instrumentation
- information processing
- vibration
- sensor update and modification
- physical sensor/system flight simulation
- image evaluation and analysis
- electro-optical sensors
- laser radar systems
- optics
- fire control simulation
- radar analysis and signal processing
- electronic combat simulation
- hybrid/real-time digital simulation laboratory
- exploitation
- integrated circuits
- receiver and processor
- electronic warfare
- multispectral signature generation

Flight Dynamics Directorate

This directorate has 90 in-house facilities capable of conducting research in the following areas:

- composite structures fabrication
- aircraft structures
- acoustic testing
- mobile data acquisition
- photomechanics
- acoustic testing
- vibration
- aerospace structures
- control systems architecture
- aircraft simulation
- wind tunnels
- water tunnels
- pilot-vehicle interface design
- crew systems integration
- crew station design
- landing gear
- launch and recovery subsystems
- center of gravity and inertia
- aircraft survivability/vulnerability

Manufacturing Technology Directorate

This Directorate is organized into four divisions: Electronics, Integration Technology, Processing and Fabrication, and Industrial Base Analysis; and three offices: Concurrent Engineering, Business Integration, and Defense Production Act. Research focuses on:

- solid state microwave systems
- microwave tubes
- infrared detectors
- energy conversion components
- semiconductor materials
- digital integrated circuits
- interconnections
- inspections and tests
- information management
- information sciences and integration
- computer integrated manufacturing
- engineering design
- operations research
- material handling and assembly
- metals and metal matrix composites processing and fabrication
- manufacturing processes for producing and utilizing propellants, plastics, resins, fibers, composites, fluid elastomers, ceramics, glasses and coatings
- productivity, responsiveness and preparedness planning

Materials Directorate

This directorate has 46 in-house facilities capable of conducting research in the following areas:

- advanced composite materials
- epitaxial film growth
- elastomer characterization
- fluids and lubricants
- space combined environment
- ceramic and composite research
- materials processing
- high temperature materials synthesis and testing
- metallography
- metallurgy
- computed tomography
- electron optics
- chemical analysis

- failure analysis
- structural materials investigation
- rain erosion
- corrosion/materials compatibility/coatings
- nondestructive inspection
- mechanical properties

Solid State Electronics Directorate

This directorate has 4 in-house facilities capable of conducting research in the following areas:

- microelectronics
- microwave/millimeter wave
- coherent and non-coherent optical device research
- device and semiconductor research

Patents for License

Pendant Benzazole Rigid-Rod Aromatic Benzoxazole
Tsu-Tzu Tsai, Fred Arnold
Patent No. 4,892,921
1/9/90

Enzthiazole Substituted Diacid Terphenyl Monomer Compositions
Fred Arnold, Jerald Burkett
Patent No. 4,892,953
1/9/90

A Method to Produce Superplastically Formed Titanium Aluminide Components
Daniel Eylon, Francis Froes
Patent No. 4,893,743
1/16/90

Alkali and Halogen Rechargeable Cell with Reactant Recombination
Stephen Vukson, David Fritts, John Leonard
Patent No. 4,894,298
1/16/90

Benzthiazole Pendent Terphenyl Rigid-Rod Aromatic Heterocyclic Polymer Compositions
Fred Arnold, Jerald Burkett
Patent No. 4,900,805
2/13/90

Rigid-Rod Aromatic Heterocyclic Copolymer Compositions
Fred Arnold, Jerald Burkett
Patent No. 4,900,806
2/13/90

Anticipating Dual Set-Point Bistable Thermostat
Charles Littell
Patent No. 4,901,917
2/20/90

Impulse Calibration of Mechanical to Electrical Transducers
R. Talmadge
Patent No. 4,909,064
3/20/90

Rotatable Photonic Coupling
Robert Morris
Patent No. 4,909,589
3/20/90

Method for Producing Titanium Aluminide Foil
Daniel Eylon, Francis Froes
Patent No. 4,910,282
3/20/90

Method to Improve Room Temperature Ductility of TI3AL
Ganapathy Venkataraman, Francis Froes
Patent No. 4,919,886
4/24/90

Airbase Sortie Generation Analysis Model
Richard Carns, Peter Flick, John Byrnes
Patent No. 4,926,886
5/15/90

Modular Resistance Heater Assembly
Kenneth Leger
Patent No. 4,927,994
5/22/90

A Method of Manufacturing Heat Pipe Wicks and Arteries
John Leonard, Jerry Beam
Patent No. 4,929,414
5/29/90

Method for Producing Alpha Titanium Alloy PM Articles
Daniel Eylon, Francis Froes, Gerhard Welsch
Patent No. 4,931,253
6/5/90

Method of Synthesis of Thermoplastic Aromatic Benzoxazole Polymers
Bruce Reinhardt
Patent No. 4,931,532
6/5/90

Smart Controller
Hsi-han Yeh, Siva Banda, Paul Lynch
Patent No. 4,949,236
8/14/90

Rigid-Rod Aromatic Benzoxazole/Thiazole Heterocyclic Copolymer
Fred Arnold, Jerald Burkett
Patent No. 4,960,853
10/2/90

Rigid-Rod Aromatic Benzthiazole/Oxazole Heterocyclic Polymer
Fred Arnold, Jerald Burkett
Patent No. 4,960,854
10/2/90

Rigid-Rod Aromatic Benzimidazole/Thiazole Heterocyclic Polymer
Fred Arnold, Jerald Burkett
Patent No. 4,960,858
10/2/90

Rigid-Rod Aromatic Bezimidazole/Thiazole Heterocyclic Copolymer
Fred Arnold, Jerald Burkett
Patent No. 4,960,859
10/2/90

Instantaneous Frequency Measurement (IFM) Receiver with Only Two Delay Lines
James Tsui, William McCormick
Patent No. 4,963,816
10/16/90

Ferrofluid Piston Pump for Use with Heat Pipes or the Like
John Leland
Patent No. 4,967,831
11/6/90

Universal Controller
Hsi-han Yeh, Siva Banda, Paul Lynch
Patent No. 4,970,638
11/13/90

Thermoset Rigid-Rod Molecular Composite System
Fred Arnold, Thaddeus Helminiak, Donald Wiff, Loonsen Tan, Hoe Chuah
Patent No. 4,977,223
12/11/90

Modifying Instantaneous Frequency Measurement (IFM) Receiver to Measure Frequency and (AOA) of Multi
James Tsui, William McCormick
Patent No. 4,977,365
12/11/90

High Efficiency Nonlinear Kerr Effect Filter
Robert Spry
Patent No. 4,986,635
1/22/91

High Performance End Grip for Guywires, Cables and Composite Rods and Tubes
Theodore Reinhart
Patent No. 5,000,611
3/19/91

Alkyl Pendent Rigid-Rod Benzobisazole Polymers
Tsu-tzu Tsai, Fred Arnold
Patent No. 5,001,217
3/19/91

Copolymer Heterocyclic Compositions Containing Alkyl Groups
Tsu-Tzu Tsai, Fred Arnold
Patent No. 5,003,035
3/26/91

Ferrofluid Piston Pump for Use with Heat Pipes or the Like
John Leland
Patent No. 5,005,639
4/9/91

Graft Copolymers of Poly (P-Phenylenebenzobisimidazole)
Robert Evers, T. Dang, D. Moore
Patent No. 5,008,346
4/16/91

Whole-wafer Etch-pit Density Mapping
David Look, James Sewell, Millard Mier, John Sizelove
Patent No. 5,008,542
4/16/91

High Temperature Solid State Hydrogenation of Gamma Titanium Aluminide for Microstructural Control
Francis Froes, D. Shong
Patent No. 5,015,305
5/14/91

Surface Preparation for Adhesive Bonding
William Purcell
Patent No. 5,015,506
5/14/91

Process for the Fabrication of Rod-like Polymer Reinforced Molecular Composite into Shaped Articles
Chyi-shan Wang, Ivan Goldfarb, Thaddeus Helminiak
Patent No. 5,021,517
6/4/91

A Method to Produce Superplastically Formed Titanium Alloy Components
Francis Froes, Daniel Eylon
Patent No. 5,024,369
6/18/91

A Method to Produce Titanium Aluminide Composites (Graded Powder Approach)
Daniel Eylon, William Revelos, Paul Smith
Patent No. 5,030,277
7/9/91

Multiple Demodulation Technique for Multiple Modulation Spread Spectrum Signal Format
Robert Clark
Patent No. 5,031,192
7/9/91

A Method to Refine the Microstructure of Beta Processed Ingot Metallurgy Titanium Alloy Articles
Daniel Eylon, Francis Froes
Patent No. 5,032,189
7/16/91

Qualitative Process Automation for Autoclave Cure of Composite Parts
C. Lee, Jack Park, Steven Leclair, Frances Abrams, Patrick Garrett, Thomas Lagnese, Ronald Servais
Patent No. 5,032,525
7/16/91

Method to Produce Fatigue Resistant Axisymetric Titanium Alloy Components
Isaac Weiss, Daniel Eylon, Gerhard Welsch, Francis Froes
Patent No. 5,039,356
8/13/91

Thermionic Fuel Element Pressure Vessel
Elliott Kennel, Mark Perry, John Leland
Patent No. 5,039,475
8/13/91

Dihydroxy Pendent Rigid-Rod Benzobisazole Polymers
Thuy Dang, Hoe Chuah, Loon-sen Tan, Fred Arnold
Patent No. 5,041,522
8/20/91

Cryogenic Mechanical Means of Paint Removal
Albert Olevitch
Patent No. 5,044,129
9/3/91

Compressed Memory Histogrammer
Joseph Caschera
Patent No. 5,063,385
11/5/91

Rod-Like Polymers with Reactive Fluorene Moities
Robert Evers, My Dotrong
Patent No. 5,066,769
11/19/91

Low Temperature Solid State Hydrogenation of Gamma Titanium Aluminide for Microstructural Control
Francis Froes, D. Shong, Young-won Kim
Patent No. 5,067,988
11/26/91

Para Ordered Aromatic Diacids Containing Benzimidazole Groups
Fred Arnold, Loon-sen Tan, Thuy Dang
Patent No. 5,081,256
1/14/92

Ionically Blended Molecular Composites
Loon-sen Tan, Fred Arnold
Patent No. 5,086,120
2/4/92

Jet Noise Suppressor and Method
Leonard Shaw
Patent No. 5,092,425
3/3/92

Thermoset Rigid Rod Molecular Composite System
Fred Arnold, Thaddeus Helminiak, Donald Wiff, Loon-sen Tan, Hoe Chuah
Patent No. 5,095,075
3/10/92

Method for Producing Very Fine Microstructures in Titanium Aluminide Powder Compacts
Daniel Eylon, Francis Froes, Leslie Steele
Patent No. 5,098,484
3/24/92

Alkyl Pendent Rigid-Rod Benzobisazole Polymers
Tsu-tzu Tsai, Fred Arnold
Patent No. 5,098,987
3/24/92

Copolymer Heterocyclic Compositions Containing Alkyl Groups
Tsu-tzu Tsai, Fred Arnold
Patent No. 5,098,988
3/24/92

Bandwidth Improvement Through Multiple Sampling of Real Signals
Richard Sanderson, James Tsui
Patent No. 5,099,194
3/24/92

Bandwidth Improvement Through Multiple Sampling of Complex Signals
James Tsui, Richard Sanderson
Patent No. 5,099,243
3/24/92

Unidirectional Heat Pipe
John Leonard, Brian Hager
Patent No. 5,101,560
4/7/92

A Method to Manufacture Titanium Aluminide Composites (Fiber Coating Concept)
Paul Smith, Daniel Eylon, William Revelos
Patent No. 5,104,460
4/14/92

Dihydroxy Pendent Rigid-Rod Bensobisazole Polymers
Thuy Dang, Hoe Chuah, Loon-sen Tan
Patent No. 5,106,940
4/21/92

Bandwidth Improvement through Phase Shifted Sampling of Real Signals
Richard Sanderson, James Tsui
Patent No. 5,109,188
4/28/92

Method to Fabricate Titanium Aluminide Matrix Composites (Beta Stabilized Alloy Concept)
Paul Smith, William Revelos, Daniel Eylon
Patent No. 5,118,025
6/2/92

High Contrast Target Discriminator
Frank Hopkins
Patent No. 5,118,191
6/30/92

Turbine Blade Cooling Method Employing Endothermic Fuel
Charles MacArthur, Richard Quigley
Patent No. 5,125,793
6/30/92

Rigid-Rod Benzimidazole Pendent Bezobisazo Copolymers
Fred Arnold, Loon-sen Tan, Thuy Dang
Patent No. 5,140,092
8/18/92

High-Transmittance, Low-Pass Optical Filter
Shawn Kelly
Patent No. 5,142,413
8/25/92

Superconducting Tunable Inorganic Filter
Robert Spry
Patent No. 5,142,418
8/25/92

Nonlinear Electromagnetic Propulsion Method and System
Rex Schlicher, Steven Rinalid, David Hall, Peter Ranon, Charles Davis
Patent No. 5,142,861
9/1/92

On-Wafer Hall-Effect Measurement System
David Look, Philip Mumford
Patent No. 5,150,042
9/22/92

Novel Cathode Material for Electrolytic Cells
David Ryan
Patent No. 5,151,335
9/29/92

Thrust Vector Control Using Internal Airfoils
Eric Herup, Milton Franke, Jerold Friddell
Patent No. 5,154,050
10/13/92

Superconducting Reflection Filter
Robert Spry
Patent No. 5,155,634
10/13/92

Laser Imaging and Ranging System (LIMAR)
John Toboada, Louis Tamburino
Patent No. 5,157,451
10/20/92

Superconducting Searching Filter
Robert Spry
Patent No. 5,161,068
11/3/92

LIMARS/1 (Laser Imaging and Ranging System/One Camera)
Louis Tamburino, John Toboada
Patent No. 5,162,861
11/10/92

Multi-Functional Optical Source
Joseph Brandelik
Patent No. 5,162,940
11/10/92

New Cathode Material for Electrochemical Cells
David Ryan
Patent No. 5,166,010
11/24/92

Laser Line Narrowing and Frequency Shifting Device Using a Nonlinear Kerr Media
Dave Cardimona, Philip Peterson, Anthanasios Gavrielides, Paul Sharma
Patent No. 5,166,942
11/24/92

Spike Rejection Line Comb Filter
Peter Land, Roger Becker
Patent No. 5,170,290
12/8/92

Cathode Material for Electrochemical Cells
David Ryan
Patent No. 5,175,068
12/29/92

Rigid-Rod Bezobisthiazole Copolymers Containing Cyclic Phosphate Esters
Fred Arnold, Jom Pin Chen
Patent No. 5,175,232
12/29/92

Process for the Fabrication of High Density, Continuous Fiber Preforms
Theodore Reinhart
Patent No. 5,178,907
1/12/93

Passive Ranging Through Global Positioning Systems (gps)
James Tsui, Rudy Shaw
Patent No. 5,187,485
2/16/93

Avionics Program Expert (APEX)
Robert Marmelstein
Patent No. 5,187,788
2/16/93

Programmable Transducer Microchip
Richard Talmadge, Kenneth Appley, Salvatore Defrancesco
Patent No. 5,191,327
3/2/93

Staggered Complementary Heterostructure FETS
Fritz Schuermeyer, Paul Cook, Edgar Martinez, Marino Martinez
Patent No. 5,192,698
3/9/93

Rigid-Rod Graft Copolymers
My Dotrong, Robert Evers, George Moore
Patent No. 5,194,519
3/16/93

Field-Induced Transparency Device
David Cardimona, Paul Sharma
Patent No. 5,196,097
3/23/93

Lubricity Additive for Polyphenylethers
Lois Gschwender, Carl Snyder
Patent No. 5,196,130
3/23/93

Synchronized Sampling of Phase Shifted Sampling Approach
James Tsui, David Sharpin
Patent No. 5,198,748
3/30/93

Aircraft Fish-Eye Electronic Alttitude Indicator Display
Andrew Probert
Patent No. 5,198,812
3/30/93

Rigid-Rod Benzobisazole Polymers Containing Cyclic Phosphate Esters
Fred Arnold, Jom Pin Chen
Patent No. 5,200,495
4/6/93

Dual Conversion Reflex Receiver
Thomas Jones
Patent No. 5,204,983
4/20/93

High Temperature (175° C) Nonflammable Hydraulic Fluid Formulation Composition
Lois Gschwender, Carl Snyder
Patent No. 5,209,861
5/11/93

Coating Apparatus for Continuous Fibers
Randall Hay, Edward Hermes
Patent No. 5,217,533
6/8/93

Liquid Nitrogen Seal for the Maverick Missile Cryocooler/Dewar Interface
Ronald White
Patent No. 5,288,703
7/20/93

Fracture Resistant Titanium Composites via a Post-Consolidation Thermal Treatment
Paul Smith, Daniel Eylon
Patent No. 5,232,525
8/3/93

Benzobisthiazole Polymers with Thiphene Moieties
My Dotrong, Robert Evers, Ronald Tomlinson, Mark Sinsky
Patent No. 5,233,017
8/3/93

Secondary Amines Containing Nadic and Benzocyclobutenyl Groups
Loon-seng Tan
Patent No. 5,233,073
8/3/93

Hydraulic Liquid Cooling of High Power, Microwave (2450 MHz) Plasma Tubes
Laverne Schlie
Patent No. 5,235,251
8/10/93

Sampling Rate Selection of Phase Shifted Sampling Approach
Richard Sanderson, James Tsui
Patent No. 5,235,287
8/10/93

Improved Method for Thermal Contrast Detailing of Inflatable Decoy Targets
Charles Littell
Patent No. 5,238,406
8/24/93

Novel Cathode Material for Thermal Cells
David Ryan
Patent No. 5,238,761
8/24/93

An Integral Cooling System for a Jet Engine Starter/Generator
Kirk Yerkes
Patent No. 5,240,069
8/31/93

Angle-of-Arrival Measurement via Time Doppler Shift
Rudy Shaw, Nicholas Pequignot
Patent No. 5,241,313
8/31/93

CRDAs

WL/XP–OATC

OATC will assist WL technology transfer efforts by acting as a liaison between WL and OATC's member organizations and clients. The assistance can come in the form of matching their clients technology need with the appropriate WL technology, assisting their members with formulating CRDAs with WL and also by collocating OATC technology transfer specialists within WL directorates. OATC's primary mission will be to market major WL technologies.
1/19/93

WL/AA-Night Vision Equipment Company

This CRDA will develop, produce, and market a finger-mounted laser spotlight. WL/AAI will provide technical assistance, documentation, and sample prototypes
11/2/92

WL/ML-Adtech Systems Research

This CRDA developed an improved automated system (computer program) for composite material analysis. The new system will permit one to analyze composite laminates, including the effect of inter laminar stress, starting from a basic knowledge of fiber, matrix, and interface properties.
1/92

WL/ML-Daychem Laboratories

This CRDA is to develop to the point of practical commercial application, a patented method of synthesizing thermoplastic aromatic benzoxazole polymers invented at WL and exclusively licensed by the Air Force to Daychem.
7/19/90

WL/ML Purdue University

This CRDA is to continue publication, distribution, and sale of the Aerospace Structural Metals Handbook, the Structural Alloys Handbook, and the Damage Tolerant Design Handbook.
6/29/91

WL/ML-Adtech Systems Research

This CRDA is for developing the Structural Analysis of Laminated Anisotropic Plates (SALAP) software into a marketable product.
2/27/92

WL/ML-Performance Plastics (CRDA #93-099-WL-01)

This CRDA is for developing commercial uses for high performance polymers and copolymers as well as polymer and copolymer blends and alloys.
5/19/93

WL/AA-Lockheed-Fort Worth (CRDA #93-126-WL-01)

This CRDA is a two-phase CRDA to define an architecture for data sharing among ground, airborne and other sources of information and to

quantify the operational merits of this network through mission simulations.
5/19/93

WL-FI-Norfield Corporation
The objective of this CRDA is to evaluate and characterize a class of sandwich core composite materials for survivable airbase structures.
10/22/92

WL/FI Spectrex
This CRDA is to develop an aerosol delivery system to protect waste/trash bins, receptacles, and storage containers and to develop an aerosol delivery system to protect electronic equipment that shall consist of both locally delivered aerosols to the electronic equipment and total flood aerosols for the spaces containing the electronic equipment.
3/10/93

WL/ML-Laser Photonics (CRDA #93-125-WL-01)
This CRDA is for test and evaluation of high power microwave Heterojunction bipolar transistors (HBT) and amplifiers which are expected to impact the development of microwave HBT power amplifiers. WL can use test results to refine device designs
6/5/93

WL/EL-Raytheon (CRDA #93-149-WL-02)
The objective of this CRDA is to work on discrete microwave HBT development for small-signal amplification in personal telecommunications application to be used in commercial cellular telephone systems. WL will obtain further insight into the operational characteristics of these devices for future performance and reliability refinements.
6/27/93

EL/EL-Northeast Consortium for Engineering Education (CRDA #93-175-WL-01)
The purpose of this CRDA is to provide a legal instrument with which small, individual work units may be initiated between WL/EL and a broad range of educational institutions within the United States. A CRDA for each one of these small efforts would not be economically feasible; thus, a single CRDA with a large University Consortium offers an excellent opportunity for transferring militarily developed and dual-use technology to academia in support of the U.S. industrial base.
8/2/93

WL/PO-Texas Instruments (CRDA #93-193-WL-01)
This CRDA will be performed to assist in the task of transitioning advanced dual-use electrical power distribution technologies (solid state power controllers (SSPC)) into future commercial and military power systems.
8/2/93

WL/EL-Harris Instruments Corporation (CRDA #93-197-WL-01)
This CRDA is for the development of an improved sensor by WL/EL exclusively for Harris Instruments Corporation to market to the commercial sector against foreign competitors.
8/5/93

WL/ML-Process Equipment Company (CRDA #93-207-WL-01)
This CRDA is for the development of an improved testing machine exclusively for Process Equipment to market to research in the fiber-reinforced ceramics field. These fiber reinforced ceramics have the toughness of steel without the high cost of ore refining or corrosion.
8/5/93

WL/PO-GE Aircraft Engines (CRDA #93-208-WL-01)
This CRDA has been established so that WL/PO's Propeller Test Facility can continue to be used to conduct tests including blade containment tests on large composite fan blades from GE. Containment testing provides valuable test data to understand the impact capability of large composite fan blades and the containment requirements of these blades. The results of this testing will be used to assist GEAE in fan blade and containment casing design in the commercial development of the GE90 engine. The test results will be provided to the WL/PO for use in the development of stress analysis techniques for composite blades under impact conditions.
8/23/93

WL/PO-Davis Engineering (CRDA #93-221-WL-01)
This CRDA is for determining the benefit of two advanced tip treatments in the Augmented Damping Low Aspect Ration Fan (ADLARF) two stage compressor operating in the Compressor Research Facility (CRF). In particular, the effects on compressor efficiency and stall margin will be evaluated.
8/29/93

WL/AA-Dr. Ching-Fang Lin (CRDA #93-207-WL-02)
This CRDA is for the production of a technical publication on state-of-the-art fire control technology, "Fire Control Handbook" and it will focus on air-to-air control for modern fighter aircraft.
8/29/93

WL/PO-Textron, Inc. (CRDA #93-264-WL-01)
This CRDA has been established to resolve existing fuel system component and thermal stability problems and design better fuel system components (i.e., fuel nozzles). Component and thermal stability problems will be resolved through the development of an improved jet fuel and antideposition surface treatment. Improvements in the design of fuel system components will be through the use of Computational Fluid Dynamics Chemistry (CFDC) code that incorporates data developed from testing of fuels and components
9/30/93

WL/EL-Phoenix Microwave Corp. (CRDA #93-231-WL-01)
Heterojunction bipolar transistors (HBT) based on GaAs are being developed at Wright Laboratory for advanced radar, communication and EW systems. The in-house development activities have recently resulted in the demonstration of devices free from thermal instabilities making them suitable for high power microwave amplifier applications. Phoenix Microwave Corp. (PMC) is a component and subsystems supplier for microwave systems used in both military and commercial applications. They have developed novel linear amplifier design techniques suitable for digital cellular telephone applications. Since HBTs are shown to be high power devices with potentially linear characteristics, the development of specialized amplifiers based on HBTs for this application is desired.
9/30/93

WL/EL-Crystal Specialities International (CRDA #93-231-WL-02)
The purpose of this CRDA is to use government expertise to help Crystal Specialities develop a better product; in this case better semi-insulating GaAs. WL/EL will benefit by having this material available for military and civilian microwave and digital circuits, and the company will benefit by having access to state-of-art research facilities and knowledgeable personnel to help develop the product.
9/30/93

WL/ML-Ribbon Technology Corporation (CRDA #93-250-WL-01)
This CRDA involved Materials Directorate scientists developing a technique for pack rolling cast titanium aluminide strip into foil. The foil produced by this technique will be used by Ribbon Technology and the military in metal matrix composites and honeycomb structures in aircraft.
9/30/93

WL/ELR-APA Optics, Inc. (CRDA #93-272-WL-01)
ELR has an existing internal program to address high temperature lasers and electronics using the GaN/AlGaN material. Under this CRDA, MOCVD-grown GaN/AlGaN material supplied by APA Optics to WL/ELR will provide critical information on material properties which will assist the MBE effort in GaN growth. No copyrightable work will be generated by this CRDA.
10/23/93

WL/ML-General Electric Co. (CRDA #93-267-WL-02)
The purpose of this CRDA is to evaluate the effects of processing conditions on texture and mechanical properties of near-gamma and gamma titanium aluminide alloys. GE will benefit by the use of techniques developed under this CRDA for processing titanium aluminide alloys in its existing business. The Air Force will benefit by the development of these techniques for processing gamma titanium aluminide alloys for use in the military.
11/3/93

Department of Defense

Air Force Technology Transition Office

Lab Description

The TTO at Wright-Patterson AFB is the Air Force focal point for all technology transition activity information. They can quickly identify sources of technology expertise within the Air Force and have a telephone help line to support this effort.

The TTO provides marketing support for command-wide technology "pushes". As a liaison between the public and private sectors, the TTO maintains continued awareness of emerging technologies that have significant potential for transfer.

Air Force Technology Transition Office (TTO)-Command Technology Transfer Team
ASC/SMT
Building 22
2690 C Street, Suite 5
Wright-Patterson AFB, OH 45433-7412
Mr. Tim Sharp
Phone: (513) 255-2421
FAX: (513) 476-7282

The TTO Transfer Team, located within the TTO, facilitates, integrates and communicates command-wide transfer activities. Their main vehicle is the Technology Transfer Integration Planning Team, whose members include the transfer focal points from every AFMC lab, center and support location.

Department of Energy

Argonne National Laboratory

Argonne National Laboratory
9700 S. Cass Avenue
Argonne, IL 60439
Ms. Shari Zussman
Phone: (708) 972-5361
FAX: (708) 972-5230

Lab Description

Argonne National Laboratory is a non-profit, multipurpose laboratory focusing on basic research in the physical, biological, and environmental sciences, and on technology-directed research in fission, fossil, and fusion energy as well as conservation and renewable energy. Argonne is a government-owned, contractor-operated (GOCO) facility managed by the University of Chicago for the U.S. Department of Energy.

Organizational Structure

The main facilities are located on a 1700-acre site 25 miles southwest of Chicago, Illinois. A second 800-acre site, located at the Idaho National Engineering Laboratory 40 miles west of Idaho Falls, Idaho, is devoted mainly to fission reactor technology.

Individual Labs with Descriptions

The laboratory comprises four research areas: Energy and Environmental Science and Technology; Physical Research; Reactor Engineering; and the recently formed Advanced Photon Source, which will operate a 7 GeV synchonotron x-ray source facility, scheduled to be in operation in 1996. The Physical Research area encompasses basic research in the fundamental sciences, including chemistry, computing and telecommunications, educational programs, high energy physics, intense pulsed neutron source, materials science, mathematics and computer sciences, and physics. Engineering research encompasses applied research in advanced fusion and fusion power reactors and national security technologies. Energy, Environmental and Biological Research entails basic research in biology and medicine, applied research in environmental sciences and fossil, solar and conservation programs. The proposed Advanced Photon Source is a 7GeV facility that will produce X-rays 10,000 times brighter than existing sources and will be used in multidisciplinary projects involving materials, chemistry, geosciences, physics and other areas.

Unique Equipment, Facilities or Services

Argonne is designated as a high-temperature superconductivity applications center. It is also involved in programs such as a parallel computing research facility; a center for environmental research; a fossil energy program; a hazardous waste program; and programs for the Nuclear Regulatory Commission.

Argonne does a limited amount of defense work in areas of expertise developed from non-defense research and development programs. Other areas of research include: basic research in advanced materials, automated reasoning, advanced fuel-cell power systems, advanced accelerators, parallel computing hardware and software, and superconductivity.

Argonne is active in the area of technology transfer including joint efforts, cooperative research and development agreements (CRADAs), consortium formation, work-for-others programs, industrial staff exchanges, research and development symposiums, user facilities, a Technology Commercialization Center for small to mid-size Illinois businesses, and patent licensing. General areas of strategic importance to the lab include: parallel computing, advanced computing

and scientific visualization, high temperature superconductivity, waste reduction and minimization, environmental assessment, advanced nuclear reactor design, magler transportation, manufacturing technologies, chemical/petroleum processing, accelerator development, and biotechnology.

A partial listing of unique user facilities available at Argonne include the Biological-Materials Growth Facility, the 4MeV Dynamitron, the High Resolution Atomic Spectroscopy Facility, the JANUS Biomedical Reactor, the Argonne Tandem Linear Heavy Ion Accelerator, the Intense Pulsed Neutron Source, and the Tandem High Voltage Electron Microscope. Argonne also operates a number of nuclear reactor-related facilities, including the Experimental Breeder Reactor-II, the Transient Reactor Facility, the Zero Power Physics Reactor, and the Hot Fuel Examination Facility, all located at the Idaho site.

Patents for License

Patents are available for licensing. Contact the Industrial Technology Development Center for more information.

CRADAs

Some of the most innovative work being done at Argonne involves collaboration with industry. Contractual arrangements may be made to facilitate and protect samples, equipment, and proprietary information, but cooperative research and development generally is done without exchange of funds. Characteristically, this would involve individual scientists working together in separately funded efforts for mutual benefit. The laboratory may enter into a nondisclosure agreement with a firm in order to discuss and participate in collaborative research and development of a proprietary nature.

Department of Energy

Chicago Operations Office

Lab Description

A major characteristic of DOE's management system is that private contractors (M&O, or management and operating, contractors) operate the vast majority of the laboratories and facilities, in what is termed a GOCO (Government-Owned, Contractor-Operated) arrangement. A number of government-owned laboratories are operated by university or industrial contractors. This approach aids the expertise and talent of universities and corporate America to help implement the Department's national research missions. In addition, the DOE mission is implemented by several Government-Owned, Government-Operated (GOGO) laboratories staffed by federal employees.

The DOE Operations Offices function as the Department's on-site manager to ensure that the operating contractors implement the work as initially planned, scheduled, and costed. The responsibilities of the Operations Offices include supporting and endorsing laboratory programs to enhance their technology transfer mission; implementing contracts, cooperative agreements, and grants with industry, universities, state and local governments, and others as needed to carry out DOE projects and programs; negotiating, executing, and administering contracts to operate the GOCO facilities; and other project and management review responsibilities delegated by DOE headquarters. In some situations, subcontractors are used as a way to include qualified third parties in performing laboratory mission assignments. In other instances, CRADAs (Cooperative Research and Development Agreements) give the GOCO laboratories a new technology transfer capability to work collab-oratively with industry that includes a mandated DOE review and approval process.

Chicago Operations Office
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AMLM
Argonne, IL 60439
Mr. Charles Pietri
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Department of Energy

EG&G Mound Applied Technologies

Lab Description

Mound is responsible for production of critical technical components for the United States' nuclear deterrent. Carrying out that mission entails more than just the production of devices like detonators. It entails an emphasis on state-of-the-art technologies ranging from material science to process technologies, from materials separation to production and quality control.

Mound is an integrated research, development and production facility performing work in support of DOE's weapons and energy-related programs with emphasis on explosives, nuclear and energy technology.

Individual Lab Descriptions

Mound's research, development, and production emphasis is on explosives and nuclear and energy technology. Research is divided into nine areas of expertise: analytical and material evaluation capabilities, ceramic technology, energetic materials, component development and manufacture, computer integrated manufacturing, welding and joining capabilities, metrology facilities, nondestructive testing, and testing and surveillance.

EG&G Mound Applied Technologies
Technology Exchange
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Miamisburg, OH 45343-3000
Mr. D. Canon Bradley
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FAX: (513) 865-3742

Analytical and Material Evaluation Capabilities

To support the entire range of products produced at Mound, as well as all research and development activities, Mound's analytical capabilities include the latest state-of-the-art instrumentation and techniques. This broad capability includes the facilities and expertise to analyze radioactive, toxic, pyrophoric, and explosive materials. This capability includes metallography and metallurgical analyses, scanning electron microscopy and surface analysis techniques. These latter capabilities include the ability to investigate the surface of tritium contaminated materials using these techniques.

Capabilities in the area of mechanical characterization of materials are also extensive. Facilities exist for conventional tensile and compressive tests to 50,000 pounds, fracture toughness, and fatigue testing. Unique capabilities include mechanical testing of radioactive materials and explosives. Among the more conventional materials characterized at Mound are metals, ceramics, plastics, and low density foams. Particular areas of expertise include simulation of explosive loading by mechanical means, failure analysis of energetic components, and computer simulation of high velocity impact.

Ceramic Technology

A broad ceramic technology base exists at Mound to execute missing assignments. This technology base is directed primarily at the manufacture of headers for use in explosive devices. Materials include glass, glass ceramics, ceramics, cermets, and the associated high temperature and high strength super alloys used to house these ceramic materials.

To accomplish this activity, an entire series of high temperature (up to 3000°C) operations and equipment are required: melting, sealing, nucleation,

crystallization, brazing, metallizing, annealing, and hot pressing. Unique capabilities include a dry room for producing ultra dry glass formulations and state-of-the-art nondestructive evaluation systems for detecting/sizing defects as small as 10 micro meters in opaque ceramic materials. Associated with and in support of Ceramic Technology, there exists an extensive ability in precision machining of ceramic materials.

Energetic Materials

Explosive and pyrotechnic materials are incorporated in many components produced or processed at Mound. Capabilities employed to produce quality materials include recrystalization of kilogram quantities of secondary explosives to provide uniform, specific crystalline structure, synthesis/production of a variety of pyrotechnic fuels and blends, microencapsulation and handleability. Significant performance diagnostics and unique characterization processes are required to evaluate the materials produced. These include emission spectroscopy, laser and shock tube initiation to evaluate sensitivities, and techniques to evaluate the basic quality of materials (laser-induced fluorescence, solid-state magnetic resonance, electron paramagnetic resonance, electrochemical analysis, laser holography, and solution calorimetry).

The capability for the formulation, consolidation, machining and evaluation of thermite materials and components is also being utilized for future applications. Unique component structures having potential applications and a unique capability is that of plasma spray forming of unusual thermite configurations.

As a result of Mound's thermite material/process technologies, experience also exists in combustion synthesis for production of certain ceramic powders and high density bodies.

Component Development and Manufacture

The capability to develop quality processes to manufacture a variety of components containing energetic materials is employed. These components include exploding bridge and slaper detonaters, explosive timers, explosive firesets and various pyrotechnic components (actuators, igniters, exploding bolts, spin rocket motors, cutter, etc.). Unique capabilities include the physical vapor deposition of precise patterns for exploding foils, chemical vapor deposition of parylene for switches, tape processing of flexible circuits for applications, precise consolidation of explosives to control densities and dimensions, and precision soldering and welding of miniature bridgewires. The effects of process and design parameters on component performance are determined by the manufacture and testing of prototype components. To assure that the components developed not only have the quality required when manufactured, but also will withstand the evironments and aging, extensive compatibility studies to evaluate material and process interactions, as well as component disassembly, are employed.

The capability to formulate and mold various plastics and plastic composites is employed in the manufacture of detonater headers and other components. Diallyl phthalate (DAP) and polyether-etherketone (PEEK) are the materials principally employed, although other materials are being evaluated. The technology to develop and evaluate adhesives and encapsulants is also employed on many components produced at Mound. Plasma treatment of surfaces is utilized to improve cleanliness and to enhance adhesion.

Computer Integrated Manufacturing

Computer integrated manufacturing, automated data acquisition, proven monitoring and proven control applications for specific purposes or for integrated systems are designed to acquire, manipulate, and report process data. Robot software and computer aided engineering software are being developed by a highly skilled staff.

Mound uses Computer Aided Design (CAD) for creation and modification of product, tool, gage, electrical, piping, instru-

mentation, site and tester design. Mound exchanges electronic geometry with other Nuclear Weapons Complex (NWC) agencies and vendors with dissimilar CAD systems through the use of translation software. Mound uses this transition software, along with ancillary tools developed to support the process, for translation of both product and facilities design information.

A flexible machining cell (FMC) was designed and built by a team of Mound engineers, programmers and toolmakers. The cell is composed of three computer numerical controlled (CNC) machine tools, and a CNC coordinate measuring machine (CMM) which provides the dimensional data for controlling the machining process. The material handling robot installed in the cell, is being developed and evaluated to provide the cell with the capability for some level of untended operations. The flexible machining cell provides for faster set up, higher through put, reduced work in process and reduced dimensional variation. Laser technology is also currently in use in the Mound Machining Operations: (1) A computer controlled laser marker has the capability to digitize and mark nearly any character (e.g., geometric symbols), in addition to numbers and letters used in identifying pieceparts, tools and gages. Parts as small as a wire paper clip can be marked clearly without surface marring. Laser engraving of symbols, logos and bar coding is also possible to assist in parts identification process. (2) A computer controlled laser cutting machine is being used in cutting metals, plastic, glass and glass ceramics.

Welding and Joining Capabilities

In support of major nuclear and non-nuclear programs, Mound has developed unique methods for joining a wide range of metals. Efforts have included the development of welding parameters and the design of joints and fixtures to provide the high degree of reliability and reproducibility required by those programs. Processes include gas-metal arc welding, gas-tungsten arc welding, and resistance welding. In addition, certain products are joined by electron beam, laser, and ultrasonic welding techniques. Heat source production programs have resulted in significant advancements in the forming, annealing, and gas-tungsten arc welding of T-111 and Hastelloy-C alloys. Currently, developments in laser welding, resistance welding, diffusion bonding (a process developed at Mound for use in tape processing) and microelectronic welding.

Metrology Facilities

Mound maintains a Metrology Laboratory to assure the accuracy of all measurements made at Mound and to satisfy the contractual requirements that those measurements must be traceable to the National Institute of Standards and Technology (NIST), formerly NBS. Rigorously defined standards are maintained for an extensive range of Dimensional, Physical, Electrical and Mass parameters to calibrate and certify measuring equipment, instrumentation, tolling and processes used in production, development, testing and quality control. The Metrology Laboratory constantly upgrades its capabilities to keep pace with requirements and to achieve greater accuracy for current and future Mound activities.

Nondestructive Testing

To support mission assignments from DOE, NASA, and other government agencies, Mound has developed extensive non-destructive inspection and evaluation capabilities. Nondestructive product inspection capabilities include x-ray radiography, ultrasonics, radiation gaging, eddy current, liquid penetrant, vibration, shock, and leak testing. These inspection methods ensure consistent manufacturing results and are a mainstay of the Quality program at Mound. Nondestructive evaluation capabilities encompass the most basic product inspection methods to the latest sophisticated material characterization and internal measurement techniques. These techniques include computed tomo-graphy, advanced image processing and analysis, laser-thermal acoustics, thermal wave imaging, and holographic interferometry. Additionally, n-ray

radiography is available from Mound's californium multiplier (CFX) neutron radiography facility. This facility, installed in 1977, produces quality n-ray radiographs previously possible only with a nuclear reactor as the neutron source.

Testing and Surveillance

Studies of new detonator designs as well as tests of current production items require the use of flash x-ray technology, interferometry, computer data reduction, and other advanced diagnostic techniques. Explosive components are prepared, detonated, and evaluated in the Mound component test facility. This new facility, a 34,000 square foot building completed in 1987, is built around three large test cells, one "single-point" test area, and four high-speed camera test systems, and incorporates real-time statistical process control.

Surveillance of aged components, many of which are returned to Mound for testing after several years in the nation's weapons stockpile, gives component designers important information on the long-term reliability of electrical parts and explosive compounds. Surveillance, electrical testing, disassembly, and test fire data obtained for nonnuclear weapon components at many locations throughout Mound are recorded and stored in a central computer database to audit the components as they move through the facility.

Patents for License

- *Mechanical Devices*

Leak Test Fitting
P. T. Pickett
Patent No. 4,282,743
8/11/81

All Metal Valve Structure for Gas Systems
R. W. Baker, D. A. Pawlak, A. J. Ramsay
Patent No. 4,482,129
11/13/84

Apparatus and Method for Pressure Testing Closure Disks
C. W. Merten
Patent No. 5,081,862
1/21/92

- *Energetic Processes*

Pyrotechnic Filled Molding Powder
L. W. Hartzel, G. E. Kettling
Patent No. 4,080,227
3/21/78

Process for Reproducibility Preparing Titanium Subhydride
R. S. Carlson
Patent No. 4,309,230
1/5/82

Integral Low-Energy Thermite Ignitor
A. Gibson, L. Haws, J. Mohler
Patent No. 4,464,989
8/14/84

Low Profile Thermite Ignitor
D. L. Halcomb, J. H. Mohler
Patent No. 4,996,922
3/5/91

Ignitor with Stable Low-Energy Thermite Igniting System
A. C. Munger, M. D. Kelley
Patent No. 4,989,515
2/5/91

Process for Forming Exoergic Structures with the Use of a Plasma
M. D. Kelly
Patent No. 4,806,384
2/21/89

Process for Forming Exoergic Structures with the Use of a Plasma and for Producing Dense Refractory Bodies, of Arbitrary Shape Therefrom
M. D. Kelly
Patent No. 4,933,241
6/12/90

High and Low-Temperature-Stable Thermite High-Pressure, High-Velocity Gases
D. L. Halcomb, J. H. Mohler
Patent No. 4,963,203
10/16/90

- *Isotope Separation*

Separation of Sulfur Isotopes
R. DeWitt, B. E. Jepson, R. A. Schwind
Patent No. 3,965,250
6/22/76

Process for Preparing a Chemical Compound Enriched in Isotope Content
E. D. Michaels
Patent No. 4,342,685
8/10/82

Liquid Phase Thermal Diffusion Isotope Separation Apparatus and Method Having Tapered Annulus
W. Rutherford
Patent No. 4,746,426
5/24/88

Rigid Indented Cylindrical Cathode for X-Ray Tube
C. R. Hudgens
Patent No. 4,560,897
12/24/85

Low-Pressure Water-Cooled Inductively Coupled Plasma Torch
D. K. Warner, C. J. Seliskar
Patent No. 4,794,250
12/27/88

• *Glass Ceramics*
Production of Glass-Ceramics with Variable Coefficients of Thermal Expansion by Application of Pressure
D. P. Kramer
Patent No. 4,536,203
8/20/85

Method and Apparatus for Performing In-Situ Vacuum Assisted Metal-To-Glass Sealing
D. P. Kramer, R. T. Massey
Patent No. 4,612,029
9/16/86

Method for Forming Glass-to-Metal Seals
D. P. Kramer, R. T. Massey
Patent No. 4,617,044
9/14/86

Production of Glass or Glass-Ceramic to Metal Seals with the Application of Pressure
M. D. Kelly
Patent No. 4,705,585
11/10/87

Glass-Ceramic Seals to Aluminum-Containing Austenitic Stainless Steels
R. T. Cassidy
Patent No. 4,921,738
5/1/90

Filter Insertion Technique for the Fabrication of Hermetic Fiber-Optic-to-Metal Components
D. P. Kramer
Patent No. 5,143,531
9/1/92

• *Chemical Processing*
Method of Producing Encapsulated Thermonuclear Fuel Particles
W. H. Smith, H. L. Turner
Patent No. 3,953,617
4/27/76

Method for Preparing Hydrate Configurations and Reactive Metal Surfaces
G. L. Silver
Patent No. 4,764,228
8/16/88

Solid-State Radioluminescent Compositions and Light Sources
J. T. Gill
Patent No. 4,997,597
3/5/91

Composition Containing Aerogel Substrate Loaded with Tritium
R. E. Ellefson
Patent No. 5,078,919
1/7/92

• *Waste Management/Environmental*
Decontamination of Plutonium from Water with Chitin
G. L. Silver
Patent No. 4,120,933
10/17/78

Method for Removing Trace Pollutants from Aqueous Solutions
G. L. Silver
Patent No. 4,572,797
2/25/86

Calcium Sulfite for Wastewater Treatment
G. L. Silver, F. S. Martin
Patent No. 5,011,610
4/30/91

Ionization Monitor with Improved Ultra-High Megohm Resistor
E. T. Burgess
Patent No. 4,755,682
7/5/88

Improved Humidification Device
R. R. Walters, B. Abernathy
Patent No. 4,622,049
11/11/80

Department of Energy

Fermi National Accelerator Laboratory

Lab Description

Fermi National Accelerator Laboratory, popularly known as Fermilab, is operated by Universities Research Association, Inc. (URA), a consortium of major universities in the United States, Canada and Japan, for the U.S. Department of Energy. DOE is the primary source of support for the research program and there is a DOE area office at Fermilab.

The primary research and development program area at Fermilab is high energy physics. In this program area, elementary particle physics is explored to broaden the understanding of the basic structure of matter. Improvement of accelerator design at Fermilab has resulted in numerous technical spin-offs: the development of superconductivity on an industrial scale, fast electronics and particle detector technology, and special computers and computer programs. The linear accelerator at Fermilab is used in cancer therapy, and the laboratory has become heavily involved in medical radiation therapy.

From a high energy physics point of view, the recent major achievement in the understanding of the universe has been the development of the Standard Model. The Standard Model is a scientific hypothesis that seeks to put order and organization into the large and confusing array of so-called elementary particles. Fermilab experiments have made, and are continuing to make, major contributions to the body of evidence that supports the Standard Model.

Fermilab, in addition to its extensive work on experiments, devotes a significant effort to the advancement of the theory of high energy particle physics. The most interesting predictions of theory guide, to a large degree, the choice of which experiments will be performed.

Fermilab is also recognized worldwide as a center of study which ties together particle physics, astrophysics, and cosmology, the study of the origin and evolution of the universe.

The laboratory formed the Fermilab Industrial Affiliates in 1980 in order to stimulate the transfer to private industry of the technical innovations developed through the basic research done at Fermilab.

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Unique Equipment, Facilities, or Services

The entire facility is designated as a Scientific User Facility. The following specific resources are included:

- Antiproton Source
- Colliding Beam Areas
- Meson Experimental Area
- National Environmental Research Park
- Neutrino Experimental Area
- Proton Experimental Area
- 1,000 GeV Superconducting Accelerator System

The principal scientific instrument at Fermilab - the Tevatron - is the final of five separate accelerators working in tandem to accelerate protons to nearly the speed of light. The Cockcroft-Walton provides the first stage of acceleration. The negatively-charged ions produced in the Cockcroft-Walton then enter a linear accelerator called the Linac which is approximately 500 feet long. Located 20 feet below ground, the Booster is a rapid cycling synchrotron 500 feet in diameter. The Main Ring is another proton syn-

chrotron which is four miles in circumference. The same tunnel which houses the Main Ring also contains 1,000 superconducting magnets which comprise the proton synchrotron known as the Tevatron.

Some of the experiments at Fermilab are performed by colliding a beam of protons with a beam of antiprotons. To produce the antiprotons, protons are first accelerated to an energy of 120 billion electron volts in the Main Ring, extracted, transported to a target area, and focused on the target. The collisions in the target produce a wide range of secondary particles including many antiprotons. These are selected and transported to the Debuncher ring where they are reduced in size by a process known as stochaistic cooling. They are then transferred to the Accumulator ring for storage.

Unique Personnel Expertise

URA is currently seeking industrial partners for various cooperative programs.

Accelerators

- Accelerator Projects. Joint programs to develop accelerators, including medical applications.
- Control Systems. Control systems that could be generalized or enhanced for wider use.

Superconductivity and Cryogenics

- Cryogenic Refrigerators. Continued improvements and upgrades on large cryogenic systems.
- Cryogenic Instrumentation. Joint development and testing of existing or new instrumentation.
- Conductor Leads. Extend existing high current cryogenic power leads to high temperature superconductors.
- Cryogenic Supports. Adaptation of existing, patented structural support technologies to other devices.

Computing

- Parallel Processors. Enhancements and extension of parallel processor technology.

Electronics

- Laboratory Electronics. Co-development of new and existing CAMAC, FASTBUS, and VME electronic modules.
- Radiation-hard Systems. New particle physics detectors require radiation-hard electronics and detectors.

Detectors

- PET. Joint development of Positron Emission Tomography instrumentation using patented crystals.
- Scintillating Fiber. Applications of new scintillating fibers to other instrumentation, e.g. medical.
- SSC Instrumentation. Superconducting Super Collider Detector instrumentation projects with industry.

Other

- Precision Alignment. Joint development of micron-level alignment and fabrication technology.
- Energy Efficiency. Site testing and co-development of energy efficient motors and power sources.

Patents for License

Universities Research Association, Inc. (URA), the organization that operates the Fermi National Accelerator Laboratory (Fermilab) under a contract with the U.S. Department of Energy, is currently offering royalty-bearing licenses on the technology items listed below.

Cryogenic Support Member
FAA No. 279
Patent No. 4,696,169

Dead Time Compensation Circuit for a Logarithmic Display Ratemeter
FAA No. 380
Patent No. 4,772,793

Computer Controlled HV Supply for Drift Chambers
FAA No. 381
Patent No. 4,888,673

Laser Pulse Stretcher Electronic Pockels Cell Controller
FAA No. 421
Patent No. 4,901,323

Zero Heat Leak, Zero Contraction Magnet Anchor System
FAA No. 430
Patent No. 4,781,034

Dynamic Seal for Air Bearing Routing Spindles
FAA No. 447
Patent No. 4,913,447

Technique for Fabricating a Multilayer Insulation Blanket
FAA No. 472
Patent No. 5,143,770

ACP Branch Bus Switch Backplane
FAA No. 488
Patent No. 4,985,830

CeF3 as a Fast Scintillator
FAA No. 519
Patent No. 5,134,293

Planar Slot Coupled Microwave Hybrids for Power Combining & Splitting
FAA No. 523
Patent No. 5,075,647

Multiple 8mm Digital Tape Handler
FAA No. 535
Patent Application Filed

Laminated Planar Temperature Sensor
FAA No. 540
Patent Application Filed

Di-Valent Dopants for Cerium Fluoride
FAA No. 563
Patent No. 5,039,858

Capacitive Probe for Gauging
FAA No. 660
Patent Application Filed

URA is also offering software packages for licensing. Specific products currently available are listed below.

ACNET, The Tevatron Control System
FAA No. 213
The package of software programs used to control the accelerators and primary beam lines at Fermilab.

BATCH DAEMON
FAA No. 428
Software to control queue access to the VAX.

Operator Interface for the Tevatron
FAA No. 559
Provides for accelerator control with consoles using the X-Window windowing system running on a DEC VAX workstation.

Table of Tables (TOT), A Computer-Aided Software Engineering Tool
FAA No. 605
A forms-driven system to aid in designing, documenting, constructing and maintaining a database structure in SYSBASE.

Department of Energy

MSU-DOE Plant Research Lab

MSU-DOE Plant Research Lab
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Lab Description

The MSU-DOE Plant Research Laboratory, (PRL), is a research institute located on the Michigan State University campus. The PRL was established in 1965 with the objective of bringing together a group of experimental plant biologists with complementary but overlapping interests and expertise to foster the development of cooperative research programs on problems which require a broad or multidisciplinary approach.

Unique Equipment, Facilities or Services

As a research institute, the PRL has exceptional research facilities. The PRL either maintains or contributes to the purchase and upkeep of specialized equipment required for state-of-the-art spectrometry, automated DNA sequencing, DNA synthesis, and protein sequencing. The PRL also maintains approximately 1500 square feet of controlled growth chamber space in approximately 100 separate units. In addition to the existing collection of biological journals of the main library and the biochemistry library, the PRL maintains a library containing journals of importance to experimental plant biology. Facilities are also available for modern cell and molecular biological research. In particular, the Macromolecular Analysis Facility has an automated protein sequenator, a peptide synthesizer, and an oligonucleotide synthesizer. The MSU Center for Electron Optics is equipped with both transmission and scanning electron microscopes. The Biochemistry Building at MSU houses an NIH-sponsored Regional Mass Spectrometry Facility. NMR, ESR, and X-ray diffraction equipment are available at the chemistry building. Most PRL laboratories utilize recombinant DNA technology and/or hybridoma technology and are fully equipped for these types of research. Students also have access to departmental microcomputer and minicomputer facilities and can access mainframe computers via ethernet connections in all laboratories. The research done by PRL faculty is supported by grants from agencies such as NIH, NSF, USDA, and DOE, and the Michigan Agricultural Experiment Station and other state and local agencies and foundations. All PRL faculty have external funding from one or more federal agencies or private foundations.

Unique Personnel Expertise

Frans J. De Bruijn, Ph.D. - Microbiology Molecular Basis of Symbiotic Plant-Microbe Interactions

Pamela J. Green, Ph.D. - Biochemistry Regulation of mRNA Stability

Ken Keegstra, Ph.D. - Botany and Biochemistry Chloroplast Protein Targeting

Hans Kende, Ph.D. - Botany and Plant Pathology Regulation of Plant Growth Development by Phytohormones

Lee McIntosh, Ph.D. - Biochemistry Molecular Biology of Energy Transduction

Kenneth L. Poff, Ph.D. - Botany and Plant Pathology Mechanisms of Gravitropism and Phototropism

Natasha V. Raikhel, Ph.D. - Botany and Plant Pathology Mechanisms of Protein Targeting

Christopher R. Somerville, Ph.D. - Botany and Plant Pathology Arabidopsis Genetics and Regulation of Lipid Biosynthesis

Shauna C. Somerville, Ph.D. - Botany and Plant Pathology Molecular Basis of Disease Resistance

Jonathan D. Walton, Ph.D. - Botany and Plant Pathology Molecular Biology and Biochemistry of Plant/Pathogen Interactions

C. Peter Wolk, Ph.D. - Botany and Plant Pathology Developmental Mechanisms in Filamentous Cyanobacteria

Jan A. D. Zeevaart, Ph.D. - Botany and Plant Pathology Regulation of Abscisic Acid Biosynthesis and Regulation of Growth by Gibberellin

Department of Energy

New Brunswick Laboratory

New Brunswick Laboratory
9800 South Cass Avenue
Argonne, Ill 60439
Dr. Carleton D. Bingham, Laboratory Director
Dr. H. Rodney Martin, Deputy Director
Phone: (708) 252-2446
FAX: (708) 252-6256

Lab Description

The New Brunswick Laboratory (NBL), a Government-owned, Government-operated facility, specializes in the analytical chemistry and measurement science of materials essential to United States defense and nuclear energy programs. As the U.S. Department of Energy's Safeguards Analytical Laboratory, NBL develops reliable measurement technology and reference materials to validate the accuracy of measurements for safeguarding special nuclear materials. NBL is located on the site of the Argonne National Laboratory (ANL), 20 miles southwest of Chicago, Illinois. NBL is part of the U.S. Department of Energy's Chicago Operations Office.

NBL occupies about 80,000 square feet of laboratory and support areas. About 5,000 square feet of the laboratory area are dedicated to plutonium chemistry.

Organizational Structure

NBL is divided into four divisions: Office of the Director; Measurement Technology Division; Safeguards Assistance and Reference Materials Division; and Operations Support Division.

Unique Equipment, Facilities or Services

Historically, NBL has performed in several general functional areas: nuclear materials analysis, measurement development, reference material certification, and laboratory/methods evaluation.

NBL develops new methods or adapts and improves existing methods of analyses for nuclear materials. Studies have been conducted on sampling techniques for materials in the scrap recovery, fuel fabrication, and related programs in the nuclear fuel cycle.

A major NBL accomplishment has been the modification of an existing reduction-oxidation titration method into a rapid, relatively interference-free, precise and accurate means for the determination of uranium now used as the primary titrimetric procedure in many laboratories around the world. The modified method has been thoroughly characterized, and variations of the method have resulted in the development of an automated system based on the constant current coulometric generation of vanadyl ion oxidant.

NBL has developed procedures for the determination of isotopic abundances of uranium, plutonium and boron. Isotope ratio measurements are carried out on a variety of computer-controlled thermal ionization mass spectrometers. Other significant studies have included: assay of enriched boron and americium by isotope dilution mass spectrometry; nondestructive determination of U-235 using a differential absorption gamma ray method; automated methods for the ion exchange separation and coulometric determination of plutonium.

The laboratory performs highly accurate and precise analyses in a wide variety of nuclear materials using volumetric, gravimetric, electrometric, spectrophotometric, flourometric, radiometric, and physical measurement techniques for uranium, plutonium, and other related elements. In many instances, NBL assumes the role of referee by performing analyses on nuclear materials transferred between two or

more parties when there are significant shipper-receiver differences. Another laboratory responsibility is determining the needs of the national and international nuclear communities for certified reference materials and for developing and providing these materials in a timely manner at reasonable costs.

The laboratory also administered the Safeguards Analytical Laboratory Evaluation (SALE) Program from 1976 until its conclusion in 1985. SALE was used to evaluate the capability of participating laboratories to analyze materials in the nuclear fuel cycle on a routine basis for nuclear materials safeguards purposes. The program also provided the means by which measurement capability could be upgraded through interchange of measurement technology. A Safeguards Measurement Evaluation (SME) Program is currently being administered to evaluate application of measurements to process-specific nuclear materials.

Unique Personnel Expertise

The technical expertise of the staff includes the following specialities: electrochemical analysis; spectrochemistry (optical, x-ray, and gamma-ray emission); isotope ratio and isotope dilution mass spectrometry; wet and instrumental chemical analysis for major and trace elements; preparation and certification of elemental and isotopic nuclear reference materials; analytical and radiochemical analysis of uranium and plutomium; mathematical statistics; health physics and industrial hygiene; and management or interlaboratory measurement evaluation programs.

Department of Energy

Notre Dame Radiation Laboratory

Lab Description

The mission of the laboratory is to conduct fundamental research in radiation chemistry and photochemistry, with particular emphasis on the rates and mechanisms of chemical reactions which are initiated by ionizing radiation or by photons. Following irradiation by electron beam or by laser, the kinetics of growth and decay of transient molecular species are probed at the picosecond to microsecond levels by optical absorption, resonance Raman, electron spin resonance, and other forms of spectroscopy. Twelve principal investigators and about ten visiting, postdoctoral and other scientists conduct the research programs at the laboratory.

Notre Dame Radiation Laboratory
University of Notre Dame
Notre Dame, Indiana 46556-0579
Dr. John Bentley
Phone: (219) 631-6117
FAX: (219) 631-8068

Organizational Structure

The laboratory is a Research Institute of the University of Notre Dame. The laboratory's Director reports to the Provost of the University. Principle investigators report to the Director.

Unique Equipment, Facilities or Services

Available experimental equipment includes a linear electron accelerator, two Van de Graaff accelerators, and nanosecond and picosecond laser flash photolysis setups.

Unique Personnel Expertise

Personnel have expertise in pulse radiolysis, radiolysis with accelerated nuclei, time-resolved ESR spectroscopy, and time-resolved Raman spectroscopy.

Department of Interior

Bureau of Mines Research Centers-Twin Cities

Bureau of Mines Research Centers
Twin Cities Research Center
5629 Minnehaha Avenue South
Minneapolis, MN 55417-3099
Mr. Stephen Swan
Phone: (612) 725-4576
FAX: (612) 725-4526

Lab Description

The mission of the bureau is to help ensure that the nation has an adequate and dependable supply of fuel and non-fuel minerals to meet its defense and economic needs by conducting research aimed at minimizing the environmental, health, and safety costs of mineral extraction and processing; acquiring and analyzing domestic and international minerals data; and engaging in activities to advance minerals and materials science. The Bureau of Mines is among the world's preeminent mining and metallurgical research organizations. The bureau's research is aimed at improving productivity, increasing resource recovery, and reducing environmental problems associated with mining.

The Bureau of Mines has had a long history of cooperative work with other federal agencies, state and local agencies, academia and private industry utilizing Memorandums of Agreement. Cost-shared contracts allow increased resources to solve a given problem and increase private industry interaction as early as possible in the development of a technology. The bureau is also authorized to enter into Cooperative Research and Development Agreements (CRADAs). These agreements can be made with state and local governments, universities, and the private sector, particularly small business. Such agreements proved each party the benefit of intellectual contributions, essential research materials, or technical resources not otherwise reasonably available. This means that there are opportunities for the private sector to use bureau facilities and personnel to pursue needed research and development activities through the mechanism of CRADAs.

Individual Lab Descriptions

The Twin Cities Research Center has a broad program that stresses surface mining, fragmentation, and advanced mining systems. The center investigates selective mining technologies such as in situ leach mining, in which minerals are leached or dissolved from their host rock and brought to the surface without removing the host material; water-jet cutting to selectively extract higher grade materials; and thermal and mechanical excavation. The effect of chemical additives on rock drilling and fragmentation and the influence of hydrology on various mining activities are evaluated as are blasting productivity, safety, and vibrations. Geotechnologic investigations are carried out in support of the bureau's ground control program and to develop improved methods of selectively fragmenting and excavating ore bodies. Environmental research includes the effects of subsidence from coal mining under prime farmland, surface reclamation, and the management of waste from various minerals industry activities. Research is carried out in iron ore benefication and processing.

Health research directed toward the reduction of airborne respirable contaminants includes improved coal cutting, mine aerosol characterization and sampling technology, coal wattability, and diesel exhaust control technology to reduce both gaseous and particulate contaminants.

Safety research on mine fires includes preventions, detections, location, and personnel

warning, as well as spontaneous combustion research. Safey research also covers conveyor systems, stability of materials piles, mobile equipment safety, and the durability of retrofitted safety equipment. The center researches the human factors approach to shiftwork, equipment maintenance, and cumulative trauma.

Unique Equipment, Facilities or Services

Facilities include a machine for cutting hard rock, novel coal cutting machinery, water jet cutting equipment, a blasting shelter, a small-scale drilling laboratory, and a microwave fragmentation unit. Dust analyzers and a diesel testing facility are used to study health hazards. Other facilities include an in situ leaching laboratory, a chemistry laboratory, geo-mineralogy laboratory, conveyor installations, a fire protections laboratory, a geotechnology laboratory and iron ore pelletizing equipment. Much of the research requires field sites.

Special equipment and facilities

- Test cell for diesel engines
- Conveyor test facility
- Water-jet research facility
- Polymer drilling laboratory
- Coal-cutting research facility
- Mechanical rock-cutting research facility
- High-temperature pellet softening or melting facility
- Iron ore pelletizing equipment
- Aerosol research and analysis laboratory

Unique Personnel Expertise

Mr. James J. Olson
Deputy Research Director
(612) 725-4560
-In situ mining technology
-Mine hydrology
-Diesel emissions and safety
-Aerosol characterization and control
-Mine fire protection
-Surface mine blasting technology
-Drilling technology
-Mechanical fragmentation
-Water-jet technology
-Thermal fragmentation
-Coal cutting
-Surface equipment safety
-Geotechnology
-Iron ore processing
-Seabed mining

Mr. Pete Chamberlain
Research Supervisor
Environmental Technology
(612) 725-4700
-blasting research
-geotechnology
-subsidence research
-environmental technology

Mr. William C. Larson
Research Supervisor
Advanced Mining
(612) 725-4690
-in situ systems
-hydrologic applications
-geochemical applications
-geomineralogy and chemistry
-rock fragmentation
-novel fragmentation

Mr. John C. Nigro
Research Supervisor
Safety Research
(612) 725-4638
-mine equipment
-mine fires
-human factors

Ms. Kelly C. Strebig
Research Supervisor
Health Research
(612) 725-4750
-Diesel research
-dust and aerosol technology
-coal cutting technology

Ms. Marilyn Anderson
Librarian
(612) 725-4503

Patents for License

Hydraulically Actuated Mechanical Rock Excavator
S. J. Anderson
Patent No. 461,950
1/90

Lead Removal from Hazardous Wastes.
E. E. Cole, A. Y. Lee, A. M. Wethington, M. G. Gorman and S. E. Paulson.
Patent No. 784,451
11/91

Method of Enhancing Rock Fragmentation and Extending Drill Bit Life
W. H. Englemann, P. J. Watson, P. A. Tuzinski, J. E. Pahlman and S. E. Khalafalla.
Patent No. 533,510
7/90

Rock Fragmentation Method
W.H. Englemann, P. J. Watson, P. A. Tuzinski, J. E. Pahlman and S. E. Khalafalla
Patent No. 211,650
6/88
South African Patent No. 85/4455 granted 2/28/90

Rock Fragmentation Method
W. H. Englemann, P. J. Watson, P. A. Tuzinski, J. E. Pahlman and S. E. Khalafalla
Patent No. 4,959,164
9/25/90

Rock Fragmentation Method
W.H. Englemann, P. J. Watson, P. A. Tuzinski, J. E. Pahlman and S. E. Khalafalla
Australian Patent No. 609689 granted 8/29/91

Method for Particle Stabilization by Use of Cationic Polymers
K.E. Hjelmstad
Patent No. 4,925,247
5/90.

Electromagnetic Fire Warning System for Underground Mines.
K.E. Hjelmstad
South African Patent No. 89/3125
2/90

Method and Composition for Controlling Dust Emissions
H. W. Kilau, J.I. Voltz, P. A. Tuzinski, J. E. Pahlman and O. L. Lantto.
Patent No. 480,197
8/90.

Pneumatic Wall-Locking Geophone System
H. L. Kuhlman, C. L. Cumerlato, and D. R. Tweeton
Patent No. 5,060,751
10/29/91

Bedded Mineral Extraction Process
R.D. Schmidt, and J. K. Ahlness
Patent No. 4,815,791
3/89

Method of Effecting Expanding Chemical Anchor/Seals for Rock Cavities
D. E. Swanson, and M. X. Schlumpberger
Patent No. 383,111
5/90

Department of Interior

National Fisheries Research Center-La Crosse

Lab Description

The National Fisheries Research Center at La Crosse, WI, conducts investigations contributing to the research and development program of the U.S. Fish and Wildlife Service. A primary purpose of this program is to collect, analyze, and synthesize scientific information needed to conserve the nation's fishery resources. The mission of the La Crosse Center is to define the environmental requirements of aquatic organisms in large river systems with emphasis on depleated stocks and endangered species; investigate and develop drugs for use in aquaculture; investigate and develop chemicals for use in fish management, especially chemical methods for controlling sea lamprey in the Great Lakes; and fulfill requirements of regulatory agencies for registration of fishery chemicals.

The Center responds to worldwide requests for technical information on the ecology of river systems, chemicals used in the management of fishery resources, drugs in aquaculture, registration of fishery chemicals, and other issues related to the Great Lakes and the upper Mississippi River. Center personnel also provide assistance to fish culturists, managers, and administrators through workshops, scientific documents, projects, systems development, and work on interagency committees.

The La Crosse National Fisheries Research Center has been designated by the Fish and Wildlife Service to negotiate registrations for fishery chemicals with regulatory agencies. Pesticides and chemicals applied to the environment are registered with the U.S. Environmental Protection Agency (EPA), and anesthetics and therapeutic drugs for treating fish diseases are registered with the U.S. Food and Drug Administration (FDA). The Center works with pharmaceutical firms, chemical companies, resource agencies, and the aquaculture industry to develop the necessary data for registration of fishery chemicals. Veterinary drugs are particularly important in aquaculture to help control fish disease that results from the intensive culture conditions of an expanding aquaculture industry. Veterinary drugs currently under study include a replacement fungicide for malachite green and new, broad spectrum drugs for use in controlling bacterial diseases of salmon, trout, and catfish.

Anesthetics are also important to aquaculture, particularly to reduce the stress from handling and transport and to maintain fish in a calm state during spawning operations.

Other chemical research includes population control of certain fish and other aquatic organisms that threaten to deplete or displace native species of commercial or recreational value. Examples of organisms that have created environmental or fisheries problems include the common carp, sea lamprey, Corbicula clam, rusty crayfish, and zebra mussel.

National Fisheries Research Center
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P. O. Box 818
La Crosse, WI 54602-0818
Phone: (608) 783-6451
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Ms. Rosalie Schnick
Hammond Bay Biological Station
11188 Ray Road
Millersburg, MI 49759
Phone: (517) 734-4768

In response to various environmental threats, the Center established a river ecology program in 1980 to study large rivers with interstate fisheries. The Center has focused much of its riverine research on the early life stages of fish, fish habitat requirements, the effects of commercial navigation and hydropower projects, and rates of mortality.

The Center's endangered species research program focuses on the life history requirements of freshwater mussels. The National Fisheries Research Center is gathering information on the ecology and habitat requirements of mussels in the upper Mississippi River and in selected large rivers in Tennessee and Kentucky.

The Center and its Hammond Bay station in Michigan continue to develop improved methods for controlling the parasitic sea lamprey, which devastated the fish population in the Great Lakes a few decades ago. The Hammond Bay field station is continually striving to improve the effectiveness of chemical formulation for the control of larval sea lamprey in streams and also investigates interactions of fish and lamprey.

Department of Interior

National Fisheries Research Center-Great Lakes

National Fisheries Research Center-Great Lakes
1451 Green Road
Ann Arbor, MI 48105
Dr. Jon G. Stanley, Director
Phone: (313) 994-3331, Ext. 200
FTS: 700-378-1200

Lab Description

The broad goal of the National Fisheries Research Center-Great Lakes (formerly the Great Lakes Fishery Laboratory) is to meet the Nation's need for scientific information for restoring, enhancing, managing, and protecting biological resources in the Great Lakes ecosystem. Functions include studying the biology and dynamics of important sport, food, and forage fish populations; measuring and protecting the impact of fishing on fishery resources; and determining how fish populations are affected by habitat modification and contamination. The Center is especially active in research relating to the restoration of naturally reproducing lake trout populations, including assessment of the stocks and strains; evaluation of habitat limitations (including contamination and eutrophication) that inhibit successful reproduction in the wild; evaluation of culture, stocking, and management practices through system-wide assessment; and assessment of the forage base.

The areas of expertise at the Center are aligned such that major problems, in the rehabilitation of fish resources and their habitats can be addressed. Those problems include the following.

Fishery Problems

- Diminished yield from some populations of endemic fishes
- Incomplete information about the magnitude and effects of fishing, sea lamprey, and other mortality factors.
- Factors impeding the development of self-sustaining populations of lake trout.
- Uncertainties about the size of populations of forage fish species critical to the maintenance of salmonid stocks.
- Uncertainties about key predator-prey interactions, larval and juvenile fish biology, energy flow through tropic levels, and the effects of these on survival and distribution of fishes.

Habitat Problems

- Physical loss or alteration of existing habitat as they would affect important fishes.
- Chemical contamination of habitats leading to contamination of biota and acute or chronic effects.
- Unknowns about habitat requirements or perturbations of key species of fish or invertebrates in areas threatened with development.
- Unknowns about the relations between physical, chemical, and biological conditions on growth, reproduction and survival of fish and fish food organisms in the Great Lakes.

Organizational Structure

The Center, formerly of the U.S. Fish and Wildlife Service is now with the new National Biological Survey. All biological research functions within the Department of Interior are now consolidated in the NBS. Consequently, researchers at Indiana Dunes National Lakeshore, Voyageurs National Park, and Pictured Rocks National Lakeshore recently joined the Center.

Unique Equipment, Facilities or Services

The Center consists of its headquarters building on the North Campus of the University of Michigan, Ann Arbor, where most of its 90 staff members are assigned; biological field stations and vessel bases at Ashland, Wisconsin; Sandusky, Ohio; and Oswego,

New York; and vessel bases at Cheboygan and Saugatuck, Michigan. The Center's five research vessels, ranging in length from 45 to 75 feet, are located on each of the Great Lakes: the *Siscowet* on Lake Superior, the *Cisco* on Lake Michigan, the *Musky II* on Lake Erie, the *Kaho* on Lake Ontario, and the *Grayling* on Lake Huron. The Center is the only agency operating on the Great Lakes with a research vessel stationed on each lake. In addition, they also operate a fleet of smaller, trailerable boats for near-shore work.

For population assessment studies in the lakes, the vessels are equipped with wet laboratories, trawls, gillnets, larval fish tow nets, equipment for limnological and contaminant sampling, hydroacoustical fish-detection systems and Loran C navigation computer systems for the precise location of sampling stations. The Center also operates a fleet of small (18-25 foot) research vessels outfitted with various types of electronic gear, including Loran C navigation systems and other equipment required for fishery and limnological research in Great Lakes nearshore and connecting waters.

Contaminant Studies

Contaminant studies at the Center are carried out with a wide range of equipment necessary for field or laboratory experiments. To measure organic contaminants in water, fish, and sediment, the Center in Ann Arbor has a gas chromatograph/mass spectrometer with positive/negative chemical ionization and purge and trap capability, gas chromatographs, gel permeation, and carbon analyzer. The chromatographs are typically used to analyze for pesticides, polyaromatic hydrocarbons, polychlorinated biphenyls, and other industrial contaminants. For inorganic contaminants, the Center has an atomic absorption spectrophotometer with graphite furnace and a DC plasma spectrophotometer. Inorganics of interest in Great Lakes biota include: arsenic, cadmium, cobalt, copper, chromium, lead, mercury, nickel, selenium, and zinc.

Because rehabilitation of fish communities in the Great Lakes cannot be achieved without habitat restoration coincident with water quality improvements, accurate assessment is essential. Using remote sensing techniques (side scan-sonar and a remotely operated vehicle), quantitative assessment of habitat quality is now possible.

Capabilities for evaluating the physiological and toxicological effects of contaminants on all levels of aquatic organisms include a high resolution microscope with computerized image analysis for histopathology, an automated blood analyzer for clinical chemistry, a thin-layer chromatography for separation and identification of different fish lipids, a high-speed centrifuge for separation of subcellular fractions, and an automated, calorimetric zooplankton counter. Water chemistry equipment for use in studies of eutrophication and the toxicity of dissolved gases, such as ammonia and hydrogen sulfide, to fish embryos consists of an elemental analyzer, an ultraviolet/visible spectrophotometer, a DC plasma emission spectrophotometer, and a fluorometer.

Fish Rearing and Holding Facilities

The Center has extensive fish rearing and holding facilities, including numerous 200- and 600-gallon fiberglass tanks, egg incubators, and various troughs for holding fish and conducting behavioral, physiological, and toxicological studies. The facilities are supplied by two 100-gallon per minute wells with associated equipment that includes iron filters, deionizers, settling tanks, permanent and portable chillers, and pumps and reservoirs for conditioning water.

Hydroacoustic Surveys

Hydroacoustic survey techniques are being developed to improve fish population estimates. The Center is equipped with hydroacoustic apparatus consisting of a 120kHz BioSonics® Model 101 echosounder equipped with 20 and 40 log10 R (range in meters) time-varied gain with two receivers for a dual-beam target strength (TS) anlysis, a BioSonics® towed body containing a dual-beam

transducer with narrow and wide beam angles of 10° and 25°, and an oscilloscope for signal monitoring.

Side-Scan Sonar

Side-scan sonar is being used to map and characterize important habitat features of fish spawning reefs. The Center is equipped with a survey-grade EG-G Model 260 microprocessor, a Model 272-T 100 kHz towfish equipped with TVG, and a Model 360 digital tape deck.

Library

The library, named in honor of Dr. John Van Oosten, contains a specialized collection of technical materials supporting the research activities of the Center. A large collection of books, journals, serials, and reprints are available at the library. In addition, the library subscribes to various online services for computerized literature searches and participates in a shared cataloging and interlibrary loan system. The Van Oosten Library collection is supplemented by access to the resources of libraries nationwide through membership in several local and national library networks. A collection of over 700 publications produced by the Center is maintained for distribution.

Computers

The Center's computer system consists of a Data General minicomputer used for statistical analysis and database maintenance and over 70 MS-DOS based microcomputers used for data analysis and word processing. Many of the microcomputers are used as terminals for the minicomputer and a number of them are equipped with modems for communications outside the Center.

Unique Personnel Expertise

Scientists at the Center are often asked or required to assist in the resolution of fishery and habitat problems. Thus, another important area of expertise is that of working to assure the proper and accurate use of information by decision-makers. This is particularly important when imperfectly coordinated management of fisheries or their habitats is shared by two or more political jurisdictions. The Center's role is that of scientific authority or advisor rather than manager or decision-maker.

Administrative, logistic, and other research support is provided to scientists by a small, but effective staff. The areas of expertise here are: biometrics and computer services, editorial assistance and graphic services, library management and information exchange, vessel management, administration, and personnel support.

Department of Interior

National Wildlife Health Research Center

National Wildlife Health Research Center
6006 Schroeder Road
Madison, WI 53711-6223
Dr. James J. Kennelly
Assistant Director
Phone: (608) 271-4640
FAX: (608) 264-5431

Lab Description

The National Wildlife Health Research Center is the National Biological Survey's only facility specializing in wildlife disease prevention and control. The Center, staffed with more than 50 scientists and support personnel, offers services and conducts activities to prevent and control wildlife diseases. Although wildlife disease is not a new or small problem, the science of wildlife diseases is relatively new and information is expanding exponentially. The staff of the National Wildlife Health Research Center produces a variety of information on wildlife diseases from original research findings and field observations to practical information on disease problems. The Center's staff is a knowledgeable source of expertise regarding animal welfare regulations and their application to wildlife.

Research is the lifeblood of the Center, and disease management in the wild is the goal of these efforts. Areas of research include wildlife immune systems (captive versus free-range), avian cholera, avian botulism, duck plague, avian tuberculosis, and methods of disease prevention.

The Center utilizes diagnostic capabilities in addition to research, often times helping to detect outbreaks of disease or patterns of transmission. Their methodical analysis of diagnostic findings has also been useful in identifying the relative importance of a number of disease problems. Diagnosticians also provide useful information or proof needed for successful prosecution in law enforcement cases. The Center also has had a major role in conducting field studies and providing expert testimony that resulted in the conversion to non-toxic shot for hunting waterfowl in the United States.

Center efforts focus on the disease host or the animal itself. Habitat alteration, contaminant exposure, crowding and nutritional problems can all affect animals. Other types of studies include techniques development for more effective disease diagnosis and control; evaluation of the frequency, geographic distribution, and species affected by specific pathogens; evaluation of the impact on various disease agents on wildlife population dynamics; and assessment of the interactions between environmental contaminants and infectious agents.

The Center's Resource Health Team is a special component of the facility. The Team will provide immediate technical assistance to field personnel who find sick and dead wildlife. The Team provides instructions on collection, preservation, and shipment of specimens for laboratory examination; and when called for, Team disease control specialists will travel to the problem area to conduct field investigations and to assist local personnel to set up and carry out disease control operations. When catastrophic events - such as major die-offs due to infections and the major oil spills in the Alaskan and Persian Gulfs - threaten the health of wildlife populations, Center staff are among those called upon to evaluate the impact on the affected wildlife. Team assistance is provided for disease problems involving all warmblooded species on Fish and Wildlife Service lands,

and for migratory birds, endangered species and other wildlife under Service stewardship on other federal lands as well as state and private property nationwide.

To keep federal and state wildlife biologists and other field personnel up to date, the National Wildlife Health Research Center sponsors workshops and seminars both at the Center and at other locations throughout the country. In addition, the Center provides in-house training for senior veterinary students, wildlife biologists, and foreign scientists. The Center also distributes information through original articles in scientific journals, Service Research Information Bulletins, brochures, and special communications projects, including video. A book-length field guide on wildlife diseases underscores the Center's goal of relating technical information and concepts about wildlife diseases to field situations and relating that information in a practical and relevant manner.

The Center's staffers travel around the world in search of knowledge, diagnoses, and cures. They have investigated wildlife diseases in the former Soviet Union, the Pacific Islands, Alaska, Mexico, Holland, Denmark, England, Canada, Puerto Rico, India, and the continental United States. The Center shares its information freely, strongly emphasizing inter- as well as intra-agency communications.

Department of Transportation

National Highway Traffic Safety Administration

Lab Description

The Vehicle Research and Test Center (VRTC) is the principal in-house research laboratory of the National Highway Traffic Safety Administration (NHTSA). VRTC performs research, development, and testing in support of NHTSA's mission of reducing motor vehicle-related accidents, fatalities, injuries, and property damage on our nation's highways.

VRTC has two main functions. The first is to perform research, development, and testing to provide the technical basis for the development of new, and the improvement of existing, Federal Motor Vehicle Safety Standards (FMVSS). The second is to conduct engineering investigations and tests to identify or confirm the existence of safety related defects in existing motor vehicles, parts, and related equipment.

To provide the technical basis for the instigation/improvement of FMVSS, the VRTC plans and performs state-of-the-art research programs in the areas of biomechanics, crash avoidance, and crash-worthiness. These research programs range from long term studies aimed at filling fundamental gaps in vehicle safety knowledge to shorter term projects that study a particular proposal for the instigation/improvement of a FMVSS.

National Highway Traffic Safety Administration
Vehicle Research and Test Center
P.O. Box 37
East Liberty, OH 43319
Mr. Michael W. Monk, Acting Director
Phone: (513) 666-4511
FAX: (513) 666-3590

To conduct engineering investigations and test to identify safety related defects in existing motor vehicles and equipment, VRTC investigates procedures for showing compliance with FMVSS, performs the environmental, load, track, and materials testing required, and then reduces, analyzes, and interprets test results to show whether or not a safety related defect is present.

VRTC also performs motor vehicle related research, development, testing, and evaluation on a reimbursable basis for other activities of the U.S. Government as staff availability permits. VRTC is located on the grounds of the Transportation Research Center (TRC). TRC has many facilities used by VRTC including:

Crash Test Facility
This facility allows vehicle-to-barrier or vehicle-to-vehicle crash tests to be performed with precisely controlled impact speeds and locations.

High Speed Test Track
A four lane 7.5 mile oval track allows vehicles to be driven at speeds in excess of 100 mph on this track.

Impact Simulator
This 24-inch Hyge sled is the largest commercially available impact simulator in the world. The pneumatic drive can carry a payload of 10,000 pounds at 44 g's.

Skid Trailer Calibration Pad
Traction trailers are calibrated on this facility in accordance with ASTM procedures.

Skid Pad
A 9,000 ft-long by 6 lane wide test area featuring a variety of pavement coefficients of friction.

Vehicle Dynamics Area
A 50 acre asphalt pad used for vehicle testing. Portions of the Vehicle Dynamics Area are paved with jennite and epoxy. When wet, these areas simulate a slippery road and an ice covered road, respectively.

Environmental Protection Agency

Center for Bioengineering and Pollution Control

Lab Description

The Center for Bioengineering and Pollution Control's (CBPC) mission is to coordinate the facilities and personnel of the University of Notre Dame College of Engineering and College of Science to provide education opportunities, laboratory space, and equipment for the development of innovative solutions to both national and international problems. CBPC was organized to provide basic research opportunities, education, the development of innovative technologies, and application of these cutting-edge technologies to real problems.

Center for Bioengineering and Pollution Control
University of Notre Dame
156 Fitzpatrick Hall
Notre Dame, IN 46556
Dr. Robert L. Irvine, Director
Phone: (219) 631-5380
FAX: (219) 631-8738
E-Mail: Robert.L.Irvine.1@nd.edu

Unique Equipment, Facilities or Services

Equipment

Below is a listing of some of the equipment available at the Center:

- Waters Photodiode Array HPLC System
- Beckman HPLC System
- Radiomatic Radio Isotope HPLC Detector
- Firmigan Mat Incos 50 GC/MS System
- Tekmar Purge and Trap Units
- Dionex IC/HPLC System
- Varian 3700 GC with FID and TCD Detectors
- Varian 3700 GC with PID and FID Detectors
- Varian 3400 GC w/ECD and FID
- Varian UV Visible Spectrophotometers
- Model DMS 200S
- Varian Cary 3 Scanning UV Visible Spectrophotometer
- Mattson Series 5000 FT-IR Spectrophotometer with Software and Data System
- Varian Spectra AA-20 abq Atomic Absorption Spectrophotometer
- Dohrmann DC 180 Total Organic Carbon Analyzer
- Malvern Zetasizer IIc microelectrophoresis and colloidal particle size analyzer
- Pyroprobe 2000 slow ramping flash pyrolyzer
- Four Controlled environment rooms
- ENRAF-NONIUS Cad-4 X-Ray diffractormeter
- Perkin Elmer 883 IR Spectrometer
- Perkin Elmer Lamda 4c Spectrometer
- General Electric GN-300 and NT-300 NMR
- Fisons VG Plasma Quad ICP/MS
- Spectrometers
- Fluorescence spectrometer with high pressure optical cell and necessary high pressure loading vessel
- Supercritical fluid solubility apparatus
- Horiba particle size analyzer
- Computer-assisted UTI 100C-02 quadrupole mass spectrometer system
- Cahn 2000 thermogravimetric electrobalance system
- Quantasorb unit for measuring BET areas and pore size distributions
- Gradientless reactors for catalytic kinetics
- Camlo Erba CHNS-O Analyzer

Services

Researchers at the CBPC have developed innovative methods of treating groundwaters and soils contaminated with such potentially hazardous compounds as benzene, toluene, ethylbenzene, and xylenes (BTEX), 2,4,6-trinitrotoluene (TNT), bis (2-ethylhexyl) phthalate (BEHP), trichloroethylene (TCE), and petroleum based products (e.g.,

gasoline, jet fuel, and diesel fuel). Utilizing *in situ* and ex-situ bioremediation, several studies currently underway are moving towards field applications.

Virtually all bioremediation schemes are directed at the enrichment and maintenance of a microbial consortium that degrade organic contaminants present in leachate and/or soils by providing native microorganisms with conditions conducive for growth, often by aggressively altering site conditions. Typically, some combination of water, nutrients, electron acceptors, co-substrates, surfactants, and, sometimes, biomass, are added to encourage the degradation of contaminants. Treatment is carried out either *in situ* or ex-situ (e.g., in above-ground reactors). The ground serves as the reactor in *in situ* bioremediation. The amendments needed are delivered to the contaminated source, eliminating the need for soil or groundwater removal. The phrase "pump and treat" usually describes above-ground reactors that are used for the ex-situ bioremediation of recovered contaminated groundwaters and leachates. Undisturbed and repacked cores are being used for *in situ* laboratory studies, and Soil Slurry - Sequencing Batch Reactors (SS-SBR's) for the ex-situ studies. Both the conventional SBR and the newly developed Granular Activated Carbon-Sequencing Batch Biofilm Reactor (GAC-SBBR) are being used to develop treatment alternatives for contaminated groundwaters and leachates.

Partially closed and closed slurry reactors have been used to supply data for mass balances on contaminants, oxygen, carbon dioxide, and nutrients and for reaction schemes which describe the stoichiometric conversion of contaminants to microbial mass. Pyrolysis-gas chromatography (GC)/mass spectrometry (MS) methods were developed to provide data on microbial production. Column reactor studies have been used to demonstrate that hydraulic conductivity (and hence the transport of oxygen) and the availability of ammonium ions is significantly affected by the cation constituents of test solutions employed.

The following is a list of ongoing research subjects:

- Radiolytic destruction of organics
- Photolytic (UV/TiO2) destruction of organics
- Biofiltration: Biological degradation of VOCs in contaminated gas streams
- Characterization of soil biopolymers: pyrolysis/gas chromatography/mass spectrometry
- Bioventing: Providing oxygen for *in situ* bioremediation by augmentation of air flow
- Trichloroethylene (TCE) degradation by nitrifying bacteria
- Degradation of contaminated soils located in cold environments
- Halophilic bacteria degradation of organics in high salt concentration waste streams
- Control of fugitive emissions with the Granular Activated Carbon-Sequencing Batch Reactor (GAC-SBBR)
- Controlled release of oxygen sources for soil bioremediation applications
- Treatment of trichloroethylene in the Sequencing Batch Biofilm Reactor (SBBR)
- Combined biofilm and suspended growth Sequencing Batch Reactors (SBR)
- Treatment of polychlorinated compounds in the SBR
- Application of white rot fungus *phanerochaete chrysosporium* to contaminated soil
- Degradation of recalcitrant organics by *phanerochaete chrysosporium*
- Anaerobic sequencing batch reactor treatment of leachates
- Removal of nitrate from groundwater
- Bioremediation of soils contaminated by metals and radionuclides
- Use of UV irradiation to enhance fungal degradation of organopollutants
- Biological treatment of organopollutants using *Aureobasidium pullulans*
- Production of commercially important enzymes from *Aureobasidium pullulans*

Unique Personnel Expertise

Joan F. Brennecke
Thermodynamics

John A. Bumpus
Biochemistry and Microbiology

Bruce Bunker
Physics

Frederick Goetz
Reproductive Physiology

Kimberly A. Gray
Water Chemistry

William G. Gray
Water Resources, Groundwater Modeling

Robert L. Irvine
Bioengineering

Lloyd H. Ketchum, Jr.
Environmental Engineering

Charles F. Kulpa, Jr.
Microbial Physiology

Thomas L. Nowak
Enzymology and Protein Chemistry

Larry K. Patterson
Radiation Chemistry

Anthony S. Serianni - Chemistry and Biochemistry

Stephen E. Silliman
Groundwater Hydrology

William Strieder
Chemical Reaction and Engineering

Arvind Varma
Chemical Reaction Engineering

Eduardo E. Wolf
Catalysis and Reaction Engineering

Environmental Protection Agency

Environmental Criteria and Assessment Office

Environmental Criteria and Assessment Office
U. S. Environmental Protection Agency
Cincinnati, OH 45268
Dr. Terry Harvey
Phone: (513) 569-7531
FAX: (513) 569-7475

Lab Description

The Environmental Criteria and Assessment Office - Cincinnati (ECAO-Cin) provides scientific leadership for assessing human health risks associated with exposure to environmental pollutants. ECAO-Cin is charged by the U.S. EPA to prepare human health-based risk assessments and methodologies for risk assessment. Many of the risk assessments are included in documents that address, but are not limited to, water and air pollution, solid and hazardous wastes for use in various regulatory activities, and related research on systemic toxicity and chemical mixtures. This office also has the responsibility for providing site-, situation-, and chemical-specific assessments covering single and multiple chemicals and complex exposures to the Program Offices and the Region. ECAO-Cin serves as a focal point for the collection, summarization, evaluation and assessment of all available data, from both national and international sources, concerning the toxic effects that may result from exposure to various environmental pollutants.

Organizational Structure

ECAO-Cin operates under the auspices of the Office of Health and Environmental Assessment of the Office of Research and Development, and is comprised organizationally as follows: the Director's Office, Information Management, Associate Director for Science, Administrative Management, Systemic Toxicants Assessment Branch, Chemical Mixtures Assessment Branch, and the Methods Evaluation and Development Branch.

Descriptions of Branches

The Chemical Mixtures Assessment Branch (CMAB) - provides scientific support for the development of background documentation and technical support necessary in the formulation of human health risk assessment activities for Agency Regional and Program Offices.

The Systemic Toxicants Assessment Branch (STAB) - also provides scientific and technical support for Agency Program Offices. These assessments establish the basis for regulatory activities, criteria and advisories associated with the potential human exposure to environmental pollutants, particularly systemic toxicants.

The Methods Evaluation and Development Branch (MEDB) - initiates and coordinates the development of risk assessment methods and Agency guidelines for chemical mixtures and noncancer health effects; reviews new methods in response to identified Agency needs; and develops and trains Agency personnel and Regional staff in the application and implementation of Agency guidelines. MEDB also coordinates the Agency's Reference Dose/Reference Concentration and Carcinogen Risk Assessment Verification Endeavor work groups, and manages the Integrated Risk Information System.

Unique Services

MIXTOX Toxicologic Interaction Database

The MIXTOX information system is a self-contained software package for the IBM-compatible or Macintosh personal computer. Data presentation includes summaries of specific interaction evaluations as well as summa-

ries across studies to pair. The data in MIXTOX are obtained from all available published studies on toxicologic interactions. The goal is to be complete, not merely representative. Exposure and toxicity are briefly described. The interaction is characterized by type and significance.

Integrated Risk Information System (IRIS)

IRIS is a database that summarizes human health risk assessment information on individual chemicals and substances. It currently contains information on approximately 500 substances, with approximately 50 new substances added each year. The primary information in IRIS includes inhalation reference concentrations (RfCs) and oral reference doses (RfDs) for noncarcinogenic effects, and carcinogenicity assessments. The carcinogenicity assessments include a weight-of-evidence for the substance's potential for human carcinogenicity and a quantitative risk estimate based upon slope factors. Assistance is available by calling the Risk Information Hotline at (513) 569-7254.

Superfund Health Risk Technical Support Center (SFTSC)

The SFTSC responds to requests for assistance from personnel involved in human health risk assessments at Superfund sites. The purpose of the SFTSC is to promote consistency in all Superfund risk assessments. A variety of information is available, including guidance on risk assessment methods and review of Superfund site-specific risk assessments.

Unique Personel Expertise

Dr. Richard C. Hertzberg
MIXTOX Toxicologic Interaction Database
(513) 569-7582
FAX: (513) 569-7916

Terry Harvey, D.V.M.
Frontiers in Human Health Risk Assessment
Phone: (513) 569-7531
FAX: (513) 569-7475

Linda R. Papa
Integrated Risk Information System
Phone: (513) 569-7587
FAX: (513) 569-7916

Harlal Choudhury, Ph.D.
Lead Uptake Biokinetic (UBK) Model
Phone: (513) 569-7536
FAX: (513) 569-7475

CRADAs

ECAO-Cin is seeking to enter into CRADAs in the following areas:

MIXTOX Toxicologic Interaction Database

- Develop efficient procedures for marketing and maintaining MIXTOX, including updating and quality assurance.
- Develop two related databases on interaction mechanisms from in vivo studies and interaction descriptions from in vitro studies. These databases will be linked to MIXTOX when they become available.
- Investigate quantitative methods for modifying or replacing the Hazard Index to incorporate toxicologic interaction potential, and modifying MIXTOX to allow Hazard Index calculation.

Frontiers in Human Health Risk Assessment

- Develop and update chemicals-biologicals-specific risk assessments for some agents of common interest to be placed on EPA's IRIS.
- Develop and apply novel categorical regression methods for estimating human noncancer health risk above EPA's Reference Dose (RfD) and Reference Concentration (RfC) for chemicals of common interest, which are on EPA's IRIS.
- Estimate site-specific consumption advisories for contaminated fish using information on EPA's IRIS and published EPA methods.
- Develop and apply novel EPA methods for combining toxicity data from several studies in order to estimate cancer risk for chemicals of common interest, that are on EPA's IRIS.
- Develop structure-activity relationship (SAR) techniques to estimate the likely range of Reference Dose (RfD) or Reference Concentration (RfC) for chemicals of common interest, that have few if any toxicity data.
- Develop and apply novel benchmark dose methods for estimating RfDs and RfCs for chemicals of common interest, that are on EPA's IRIS.
- Develop comparative risk assessment techniques for human health for municipal

solid waste reuse and disposal options (i.e., recycling, composting, incineration, and landfilling).

- Develop communication strategies for risk assessment information and technology transfer capability of risk assessment techniques.
- Develop common measures for ecological and human health risk assessment involving both theoretical and field work.

Integrated Risk Information System

- Commercialize IRIS. IRIS is used by government and private organizations here in the United States, but the demand for access is greater than EPA can support. There is a wider audience that has a need for IRIS information world-wide. EPA would welcome collaboration to develop and market a commercial version of IRIS the highest quality risk system in the world.
- Integrate IRIS with other interactive databases or systems. IRIS data are used in a larger risk characterization/ management process that requires other types of information available in other databases and systems. An integrated system that conveniently packages the diverse information needed to develop high quality risk characterizations would be of interest to a large world-wide audience.
- Translate IRIS into other native languages, Spanish, German, Chinese, etc. Other countries are faced with many of the same environmental and health problems as the United States and are desperate for high-quality risk information. Translating IRIS into one or more languages would open up an even wider audience for this information.
- Expand the scope of IRIS. Opportunity exists to collect and disseminate additional information useful in conducting risk characterizations. This may include federal and state regulations, chemical-specific exposure parameters, and chemical and physical properties.

Lead Uptake Biokinetic (UBK) Model

New data are now being collected and analyzed in collaboration with the Regional Superfund Program to help resolve two controversial issues:

1) the bioavailability of lead in various soil/dust matrices from various sources, such as those found at urban and rural sites, and

2) site-specific population variances in the distribution of blood lead levels may be greater than the national average.

An expanded version of the model (version 5), which contains additional features that allow the user to produce a series of model runs for site-specific assessment, is currently undergoing review at Superfund sites. A Guidance Manual is under development for the use of the lead UBK model at Superfund sites and is currently being revised to reflect comments of the Agency's Scientific Advisory Board.

Opportunities for collaboration in this area include:

- The development of the lead UBK model was feasible and scientifically credible because of the strong database on lead. Collaborative efforts to produce such data for other chemicals (including non-metallics) are essential. Specifically, information on the absorption of contaminants from multiple routes is necessary.
- The Agency is currently evaluating new data and seeking additional data to enhance the preliminary maternal-to-fetal model for lead.
- Collaborative efforts are necessary on the utilization/ application of the model for site-specific use to determine its usefulness and validity.
- Feasibility of the application of components of the current modelling procedure to other metal contaminants (e.g., Cu, As, Hg) need evaluation.

Environmental Protection Agency

Environmental Monitoring Systems Laboratory

Environmental Monitoring Systems Laboratory
26 W. Martin Luther King Drive
Cincinnati, OH 45268
Mr. Thomas Clark
Director
Phone: (513) 569-7301
FAX: (513) 569-7424

Lab Description

The mission of EMSL-Cincinnati is to develop, evaluate, and standardize analytical methods and qualify assurance procedures and materials that are used to acquire data to monitor and assess the status of the environment. Included are chemical methods to identify and measure inorganic and organic pollutants and biological methods to detect, identify, enumerate, and evaluate effects of bacteria, fungi, viruses, protozoa, and parasites. In addition, methods and models are developed to detect and quantify responses in aquatic and terrestrial organisms exposed to environmental stressors and to correlate the exposure with effects on chemical and biological indicators. Two emerging areas of research involve human exposure. One issue is the need for standardized methods to determine the type, extent, and effects of airborne-microorganisms in indoor environments. Another involves development of procedures and acquisition of data to assess the nature and extent of human exposure to pollutants ingested through food and beverages.

The laboratory provides quality assurance and support to maintain and document the scientific credibility of the Agency's monitoring data for water, wastewater, and solid waste/Superfund/toxics, including data generated by USEPA regions, contractors, and state and local agencies. Studies are conducted to ensure that the Agency's selected chemical and biological methods provide adequate data of known quality and that laboratories using those methods are providing data of acceptable quality. Quality control samples, calibration standards, and performance evaluation samples are designed, tested, and made available through contracts or cooperative research and development agreements.

EMSL-Cincinnati has a major responsibility in the Agency's process for certification of laboratories providing data to monitor the quality of the nation's drinking water. Through a tiered process, EMSL-Cincinnati certifies regional laboratories, who certify state laboratories, who certify local government and private laboratories. In addition, the laboratory trains drinking laboratory certification officers from all over the nation and its protectorates at annual chemistry and microbiology training courses presented in Cincinnati.

Organizational Structure

The Environmental Monitoring Systems Laboratory in Cincinnati (EMSL-Cincinnati) is one of the 12 research laboratories in the Office of Research and Development (ORD) of the U.S. Environmental Protection Agency (USEPA). EMSL-Cincinnati is part of ORD's Office of Modeling, Monitoring Systems and Quality Assurance, which is responsible for quantifying the exposure of humans and ecological resources to pollutants and for supporting the Agency's regulatory programs involving all environmental media.

EMSL-Cincinnati is organized into four research divisions: Chemistry, Microbiology, Ecological Monitoring, and Quality Assurance. A Program Operations Staff supports and coordinates all laboratory activities.

Individual Lab Descriptions

Chemistry Division

The Chemistry Division is responsible for development, evaluation, demonstration, and standardization of sampling procedures (collection, preservation and shipping), analytical methods, QA/QC practices, reporting procedures, and data transmission and storage. Included are automated techniques using electronic data collection, manipulation, and transfer systems. These methods and procedures are used by Agency program offices to set and enforce standards and regulations for ambient water quality, drinking water, ground water, wastewater, indoor air, and solid waste. In the Inorganic Branch, major areas of interest are determination of metals, inorganic ions, and organometallic compounds through application of inductively coupled plasma (ICP) emission spectrometry, ICP Organic Branch uses a variety of analytical instruments, including computerized systems integrating mass spectrometers with gas and liquid chromatographs to develop, demonstrate, and standardize analytical methods for identification, characterization, and quantitative determination of organic environmental pollutants.

Ecological Monitoring Research Division

The Ecological Monitoring Division's research activities focus on bioindicators that can serve as early warnings of an ecological area's environmental distress. Aquatic or terrestrial organisms that demonstrate problems (such as development of tumors) during early stages of pollution can be monitored to assess human, aquatic, and ecological exposure to harmful pollutants. With information obtained by monitoring bioindicators, ecosystems at risk can be identified for remediation before the damage becomes irreversible. The sensitivity and reliability of these indicators are evaluated both in a controlled laboratory environment and in various ecosystems to assess their ability to detect and quantify ecological exposures to important environmental stressors. Methods are evaluated to demonstrate their usefulness for improving ecological risk assessment including: monitoring toxicant exposure levels; identifying dose to aquatic and terrestrial species, and quantifying the general ecosystem health using ecological monitoring techniques. Division research goals are achieved through the integrated efforts of biologists, chemists, toxicologists; ecologists, and statisticians working in three branches: Cellular and Biochemical Markers, Bioassessment and Ecotoxicology, and Physiological and Clinical Indicators.

Microbiology Research Division

The Microbiology Division conducts research on methods for detecting, identifying, and quantifying microbial indicators and pathogens found in water, wastes, soil, and air. Methods are developed, evaluated, and standardized to determine the occurrence, distribution, transport, and fate of microorganisms in the environment. Studies are conducted to determine the virulence of infectious agents, the potential for human exposure to them, and the health and ecological effects associated with viruses, bacteria, and parasites in the environment. Immuniassay techniques are developed and applied to determine the viability, virulence, speciation, and growth characteristics of bacteria, viruses, and parasites. Emerging biotechnology is being used to develop innovative methods using gene probes. Quality assurance guidelines are developed for promulgation in Agency manuals, and reference materials are produced. The Division has a multidisciplinary skill mix distributed among three branches: Virology, Bacteriology, and Parasitology and Immunology.

Quality Assurance Research Division

The Quality Assurance Division provides quality assurance support for various Agency programs, including standardization of methods

for aquatic biology, collaborative multilaboratory studies to evaluate the Agency's chemical and biological methods, and large-scale studies to assess analytical laboratory performance. Acute and chronic toxicity tests are developed and validated for wastewater, ambient water, and sediments. Through Division extramural and in-house programs, industrial waste and synthetic quality control samples and calibration standards are made available to laboratories providing environmental monitoring data. The Division also develops, analyzes, and distributes natural-matrix, liquid, and solid performance evaluation samples to laboratories analyzing samples in support of Agency regulations and reports statistically evaluated results to the appropriate program office. These tasks are performed through a Project Management Branch and a Development and Evaluation Branch.

Unique Equipment, Facilities or Services

Except for one branch, EMSL-Cincinnati personnel are located in the Andrew E. Breidenbach Environmental Research Center, one of the largest USEPA research facilities. Dedicated in 1975, the Center consolidated several Cincinnati environmental facilities that had established an international reputation for water research. With its state-of-the-art facilities and highly experienced staff, the Center has continued this tradition of excellence in water research and has become a leader in new areas of concern (such as hazardous and solid waste management) that have emerged in recent years. At the Center, EMSL-Cincinnati's Ecological Monitoring Research Division (EMRD) maintains a unique, well-equipped facility to conduct ecotoxicological research with aquatic and terrestrial organisms. This facility features animal rooms (about 7,680 ft^2), aquatic testing rooms (about 2,000 ft^2), surgery and necropsy rooms, and a modern incinerator. Organisms involved in current research include fish, tadpoles, field mice, earthworms, laboratory rodents, and plants. The Bioassessment and Ecotoxicology Branch of the EMRD is located in a Cincinnati suburb, Newtown, where scientists study the effects of pollutants on living aquatic organisms and use this information to develop standards for evaluating aquatic toxicity. At Newtown, aquatic test organisms are raised and made available to USEPA regional laboratories as well as state and private laboratories.

On the Center grounds, EMSL-Cincinnati manages the Research Containment Facility for Hazardous Wastes. Construction of this specialized facility was completed in 1989; it incorporates maximum safety features to preclude exposure of employees or the surrounding community to hazardous materials used to evaluate methods to test or treat hazardous wastes. Also at the Center are state-of-the-art facilities and equipment shared with other Agency organizations in Cincinnati. Included are a specialized technical library, an extensive computer facility and support personnel, a state-of-the-art electron microscope, and a suite of laboratories specially designed and operated to allow safe study of disease organisms (e.g., viruses and pathogens) that pose human health risks.

Unique Personnel Expertise

EMSL-Cincinnati research is performed by a workforce of about 125 USEPA employees (intramural personnel), visiting scientists, and 90 on-site extramural personnel who work under contracts, cooperative agreements, and interagency agreements (i.e., transactions with state and other Federal agencies). Included among intramural personnel are students who work part-time under cooperative education or "stay-in-school" programs.

Below are key personnel names and telephone numbers. Personnel in the Bioassessment and Ecotoxicology Branch at Newtown can be reached at (513) 533-8114.

Mr. Thomas Clark
Director
(513) 569-7301

Mr. Gerald Mckee
Deputy Director
(513) 569-7303

Mr. James Lichtenberg
Science Advisor
(513) 569-7306

Ms. Ann Alford-Stevens
Science Advisor
(513) 569-7492

Mr. Harold Clements
Containment Facility Manager
(513) 569-7398

Mr. Alfred Dufour
Director, Microbiology Research Division
(513) 569-7218

Mr. William Budde
Director, Chemistry Research Division
(513) 569-7309

Mr. John Winter
Director, Quality Assurance Research Division
(513) 569-7325

Mr. Bernard Daniel
Director, Ecological Monitoring Research Branch
(513) 569-7401

CRADAs

American Water Works Association Research Foundation - Biotechnology and tissue culture methods for monitoring viruses in ground water.

Fisher-Scientific Company and R.T. Corporation - Research and development of solid matrix quality control samples.

NSI Technologies, Inc. - Research and development of liquid organic standards and preparation, verification, distribution, and stability of these samples.

Perkin-Elmer Corporation - Development of sampling methods for the PCR technology

Spex, Inc. - Research and development of inorganic reference materials and preparation, verification, distribution, and stability of these samples.

Supelco, Inc. - Research and development of liquid organic standards and preparation, verification, distribution, and stability of these samples.

Ultra Scientific, Inc. - Research and development of organic reference materials and preparation, verification, distribution, and stability of these samples.

Environmental Protection Agency

Environmental Research Laboratory - Duluth

Environmental Research Laboratory - Duluth
6201 Congdon Blvd.
Duluth, MN 55804
Dr. Steven F. Hedtke
Acting Director
Phone: (218) 720-5550
FAX: (218) 720-5539
E-mail:
Hedtke.Steven@pyxis.rtpnc.epa.gov

Lab Description

The Environmental Research Laboratory at Duluth (ERL-D) conducts research to advance the fundamental understanding of aquatic toxicology and freshwater ecology. Its mission is to develop a scientific basis for EPA to create environmental policies concerning the use of freshwater resources. To accomplish this, ERL-D conducts the research development, and technical assistance programs described below.

Organizational Structure

ERL-D is composed of six research branches and has field research stations at Grosse Ile, MI and Monticello, MN. ERL-D is part of the EPA's Office of Research and Development located in Washington, D.C.

Research Branches

Regulatory Ecotoxicology Branch

The Regulatory Ecotoxicology Branch develops and evaluates methods for identifying hazardous xenobiotics in freshwater effluents, surface waters, and sediments, defining toxicity and other adverse effects, and developing protocols that can be used as regulatory tools to help identify environmental hazards from separate industrial chemicals and their mixtures to specific freshwater aquatic life and ecosystems. Regulatory ecotoxicologists are active in the design of sediment quality criteria

Ecosystem Response Branch

The Ecosystem Response Branch seeks to quantify dose response relationships and indirect effects of stresses on freshwaters. Specialized methods involving microcosms, mesocosms, streams, ponds, wetlands, and small lakes are used to provide the basis for models and extrapolation techniques. The knowledge has been incorporated into testing protocols for pesticides registration. Members of this branch are active in the research and implementation of EMAP in the Great Lakes.

Landscape Ecology Branch

The Landscape Ecology Branch specializes in the diagnosis of ecosystem dysfunction and developing indicators of ecosystem health. As EPA moves closer to programs for better management practices from a watershed perspective, we expect to provide much of the guidance to protect and improve water quality. This branch also leads the ORD effort to understand the impact of nonindigenous species on freshwater systems.

Large Lakes and Rivers Branch

The Large Lakes and Rivers Branch is focused primarily on the Great Lakes and the science necessary for lake-wide management planning. This research uses the mass balance framework to integrate large-system impacts and responses to changes in pollutant loadings. The development of mass balance models for Green Bay, Michigan, the integration with air modeling efforts, the impact of exotic species, and the process studies to reduce the uncertainties of model predictions are important ongoing studies.

Predictive Toxicology Branch

The ability to understand and predict the effect of chemicals on aquatic life remains the focus of the Predictive Toxicology Branch. A complete array of computerized models for structure-toxicity relationships, toxicokinetic extrapolations, and dynamic toxic effects are being developed based on fundamental research. Studies to determine the ecological significance and adequacy of existing laboratory-derived hazard assessments for protecting aquatic life are being conducted. A new thrust seeks to validate low-cost fish models in the classification of chemical carcinogens.

Risk Characterization Branch

The Risk Characterization Branch develops and applies procedures for integrating information on toxicology, ecology, and environmental chemistry into statements of risk concerning anthropogenic stresses on aquatic ecosystems. Specific research is directed at identifying and reducing important uncertainties, especially regarding linkages among the various components of a risk characterization. Efforts include risk characterizations for specific chemicals, such as 2,3,7,8-TCDD, and development of guidelines for water quality criteria.

ERL-Duluth research is concentrated in the following areas:

- Develop a sound understanding of the effect of chemical, physical, and biological insults to aquatic ecosystems; determine levels that will not harm aquatic life and consumers of aquatic organisms; share the expertise and data resources with EPA regional and program offices, other agencies and scientists, and the public.
- Develop common denominators, quantitative structure-activity relationships, and models that can be used to predict or assess the impact of chemical and physical pollutants on aquatic and aquatic-related organisms.
- Evaluate the ability of laboratory test methods and models to predict the fate and effects of contaminants under field conditions through use of ecological studies.
- Identify biological indicators of ecological conditions of the Great Lakes and determine the role of nonindigenous species on the sustainability of these ecosystems.

Environmental Protection Agency

Great Lakes and Mid-Atlantic Hazardous Substance Research Center

Great Lakes and Mid-Atlantic Hazardous Substance Research Center
Michigan State University
C231 Holden Hall
East Lansing, MI 48824-1206
Mr. Walter Web
Phone: (313) 763-1464
FAX: (313) 763-2275

Lab Description

The mission of the Great Lakes and Mid-Atlantic Hazardous Substance Research Center (GLMAC) is to foster and support integrated, interdisciplinary, and collaborative efforts that advance the science and technology of hazardous substance management to benefit human and environmental health and well-being. The Center provides the philisophical framework, organizational structure, and other resources required to carry out this mission. The Center promotes integrated university based research programs focused on common sets of objectives, and fosters joint participation of researchers from different disciplines to ensure a rich resource of aproaches and perspectives. Collaboration and interaction with industry, government, other academic institutions, and the general public are key elements of the Center's comprehensive program of research, education, and technology transfer.

GLMAC specializes in bioremediation. Most of the research is directed towards this goal. Soil, ground water, and open water projects have been funded, as well as specialized projects to investigate successful methods and efficiencies of technology transfer.

Organizational Structure

GLMAC is a consortium of three prestigious universities in the Federal EPA Region III and Region V areas. The Center Director is located at the University of Michigan in Ann Arbor. The other two offices are located at Michigan State University in East Lansing and Howard University in Washington, D. C. The Center is one of five such centers in the country, funded by U.S. EPA in 1988 as an outgrowth of the concern for innovative research and technology development in the field of hazardous waste management.

Unique Equipment, Facilities or Services

Technology transfer is carried out by the wide distribution of knowledge gained from research to those who can use it in the field. The primary method of the GLMAC is the twice a year publication of *synergos*, the Center's research chronicle. Other methods are training videotapes, manuals, conferences, workshops, and teacher training materials.

Unique Personnel Expertise

Two highly qualified advisory groups, one called the Science Advisory Committee and the other the Technology Transfer Advisory Committee give advice and offer peer review of the research proposals. Their participation keeps the Center's efforts focused and helps maintain the high quality of scientific research the Center is known to produce.

CRADAs

The following is a current list of research projects:

Phase Equilibria and Transport Properties of Surfactant Systems of Interest to Soil Remediation
L. M. Abriola
University of Michigan

Laser Photodegradation of Polychlorinated Biphenyls and Related Compounds
S. Paurus
University of Michigan

The Effect of Surfactants on the Transport Properties of Aquifiers During Remediation
A. H. Demond
University of Michigan

Remediation of Contaminated Aquifiers with Surfactants: The Effect of Surfactant Adsorption and Desorption
K. F. Hayes and K. Srinivasan
University of Michigan

Use of Chemical Oxidants for the Degradation of Tetrachlorobenzenes and Chlorinated Biphenyls in Aqueous Systems and Sediments
S. J. Masten and S. Davies
Michigan State University

Thermophilic Bioremediation
P. Oriel
Michigan State University

Mechanisms Governing the Release of Contaminants from Sediments Resuspended During Dredging Operations
S. Davies and T. Voice
Michigan State University

Solid Phase Aerobic/Anaerobic Treatment of Polycyclic Aromatic Hydrocarbon Compounds
J. H. Johnson Jr. and E. J. Martin
Howard University

Construction of DNA Probes to Identify and Overexpress Bioremediation of Specific Aromatic and Halogenated Organic Compounds
S. K. Dutta
Howard University

Hazardous Waste Treatment by Co-Metabolism in Sequencing Batch Reactors
C. S. Criddle
Michigan State University

Factors Limiting Microbial Degradation of Polynuclear Aromatic Hydrocarbons
J. Kukor and R. H. Olsen
University of Michigan

Characterization of Aromatic Dechlorinase Genes
J. M. Tiedje
Michigan State University

Knowledge-based Bioremediation Advisor
I. D. Tommelein
University of Michigan

Reductive Dechlorination of Chlorinated Aromatics by Bacterial Transition Meta Enzymes
T. M. Vogel
University of Michigan

Develop Design and Operating Parameters for the Remediation of a Fuel Oil Contaminated Soil Using Composting Technology
J. H. Johnson, Jr.
Howard University

Environmental Protection Agency

National Vehicle & Fuel Emissions Laboratory

Lab Description

This laboratory hosts the federal government's principal program for controlling pollution from mobile sources. Such sources include garden equipment and recreational vehicles as well as automobiles, trucks, buses and aircraft. Work at the NVFEL includes development of regulatory programs, evaluations of emission control technology and determination of compliance with federal emission and fuel economy standards.

National Vehicle and Fuel Emissions Laboratory
2565 Plymouth Road
Ann Arbor, MI 48105
Mr. John T. White
Phone: (313) 668-4353
FAX: (313) 668-4440

Organizational Structure

The EPA's Office of Mobile Sources is administered by an Office Director located in Washington, D.C. Its four technical divisions are located at the National Vehicle and Fuel Emissions Laboratory in Ann Arbor. For the purpose of the FTTA, three Directors are authorized to enter into CRADAs or related arrangements.

Individual Lab Descriptions

The Director of ***Regulatory Programs and Technology (RPT)*** oversees efforts to:

- characterize emissions
- develop regulations
- assess new technology
- evaluate in-use performance of vehicles
- maintain heavy-duty engine testing facilities
- develop inspection/maintenance programs
- investigate alternative fuels

The Certification Division (CD)

The CD's focus is to

- Review and evaluate manufacturers' applications for the certification of motor vehicles
- Administer the fuel economy program along with the federal Departments of Transportation, Energy, and Treasury
- Develop test procedures and regulations for non-road engines.

The Engineering Operations Division (EOD)

The EOD performs the following functions:

- Performs motor vehicle emission tests for the certification fuel economy, and recall and in-use programs
- Provides support services, such as maintenance and calibration of equipment
- Performs chemical analyses of fuels, additives and products of combustion
- Maintains the laboratory computer system

Unique Equipment, Facilities or Services

The NVFEL operates an emission testing facility that is the model for the rest of the world. In addition to facilities for testing of vehicles and engines for emissions and fuel economy, NVFEL maintains a chemistry laboratory that is capable of analyzing any automotive-related substance.

Unique Personnel Expertise

NVFEL employs over 400 individuals, most of whom are specialists in motor vehicle emission control technology and its practical applications.

CRADAs

Measurement Technologies for Motor Vehicle Emissions

The CRADA brings together engineers and scientists from the U.S. Environmental Protection Agency (EPA), the California Air Resources Board (CARB), Chrysler, Ford, General Motors, and Navistar.

Industry participants in this project are working under the auspices of the Environmental Research Consortium (ERC) within the United States Council for Automotive Research (USCAR).

The purpose of this CRADA is to help commercialize new technologies for the measurement of evaporative and exhaust emissions from cars and trucks. The goal will be reached through the identification, encouragement, development and evaluation of equipment, facilities and techniques to enable industry and government agencies to properly test vehicles in accordance with the provisions of the Clean Air Act Admendments of 1990 and recent regulations by the State of California.

Research on exhaust emissions will focus primarily on instrumentation and methods for measuring low levels of hydrocarbons, carbon monoxide, oxides of nitrogen and non-methane organic gases. The detection and quantification of specific hydrocarbons, oxygenates and other compounds emitted from conventional and alternate-fueled vehicles will also be studied. Research in the area of evaporative emissions will primarily involve the enhancement of equipment and test procedures.

Evaluation of Electric Lawnmowers

The purpose of this CRADA between the Electric Power Research Institute (EPRI) and the Certification Division is to assess the air quality benefits of advanced electric lawnmowers. The emissions benefits are being studied through a program in which EPRI has obtained a hundred or so in-use units by trading them for new, sophisticated, self-contained electric models. The gasoline-fueled models taken in will be tested at NVFEL to gather emission data which can be used to calculate and project possible air quality benefits through more widespread conversion to electric power for garden equipment.

Environmental Protection Agency

Risk Reduction Engineering Laboratory

EPA Risk Reduction Engineering Laboratory
Cincinnati, OH 45628
Mr. E. Timothy Oppelt
Phone: (513) 569-7418
Mr. John Convery
Phone: (513) 569-7896
FAX: (513) 569-7680

Lab Description

The Risk Reduction Engineering Laboratory's mission is to advance the understanding, development, and application of engineering solutions for the prevention of risks from environmental contamination. This mission is accomplished through basic and applied research studies, engineering technology evaluations, new process development, and demonstration studies designed to:

- Enhance our understanding of environmental engineering technology design, performance and operation.
- Anticipate engineering control and prevention measures for environmental problems not of immediate regulatory or enforcement concern.
- Provide a sound scientific basis for development and enforcement of environmental regulations, standards, guidelines, and policy decisions in areas for which the EPA is responsible.
- Foster the development, evaluation, and commercialization of improved and innovative environmental engineering technology in collaboration with industry.
- Provide a basis for technical assistance and engineering support to EPA, regional, state, municipal, and other government organizations, and private industry regarding the implementation of environmental regulations, standards, and guidelines.

Lab Subdivisions

The Risk Reduction Engineering Laboratory is composed of four divisions: Drinking Water Research, Superfund Technology Demonstration, Waste Minimization, Destruction and Disposal Research, and Water and Hazardous Waste Treatment Research.

The Drinking Water Research Division houses four branches: Inorganics and Particulates Control, Microbiological Treatment, Organics Control, and Systems and Field Evaluation.

The Superfund Technology Demonstration Division's three branches are the Releases Control Branch, Site Demonstration and Evaluation Branch, and the Technical Support Branch.

The Waste Minimization, Destruction and Disposal Research Division encompasses the Municipal Solid Waste and Residuals Management branch, the Pollution Prevention Research branch, and the Thermal Destruction branch.

The Water and Hazardous Waste Treatment Research Division consists of the Biosystems Branch, the Physical/Chemical Systems Branch, and the Toxics Control Branch.

Individual Lab Descriptions

Drinking Water Research Division

The Inorganics and Particulates Control Branch conducts studies and evaluations of water treatment processes for the removal or control of inorganic and particulate contaminants, including radionuclides, in drinking water.

The primary mission of the Microbiological Treatment Branch is the development of technology for the removal and inactivation of microbial contaminats, including pathogenic viruses, bacteria, and protozoa. The Branch evaluates microbial barrier protec-

tion in innovatives processes, including point-of-use and point-of-entry processes appropriate for the needs of small community systems and non-community systems.

The Organics Control Branch, with its multidisciplinary staff, conducts research to understand the fundamental scientific principles underlying the function of drinking water treatment organic removal unit processes, as well as the formation of byproducts of chemical treatment (disinfection byproducts).

The Chemical Studies Section of the Organics Control Branch conducts research to understand the chemistry of water matrices, disinfectants, and disinfection byproducts to provide a scientific basis from which drinking water treatment unit process studies can be designed and evaluated for control of byproduct formation and the maintenance of adequate disinfection.

The Systems and Field Evaluation Branch, with a multidisciplined staff of sanitary and environmental engineers, operations research analysts, and computer specialists, has the primary function of providing an integrated analysis of cost and performance of technology associated with supplying safe drinking water to the public. This group also evaluates the interaction of cost and factors affecting the deterioration of drinking water quality in water delivery systems.

The Engineering and Cost Section of the Systems and Field Evaluation Branch has the primary function of providing an integrated analysis of cost and performance of treatment technology required to supply safe drinking water to the public. Modular or full-scale research emphasizes both performance and the costs associated with construction, operation, and maintenance. This Section also designs and develops computer output displays for geographical information system (GIS) and distribution systems. A major emphasis of this Section is the study of small systems alternatives.

The Treatment Operations Section of the Systems and Field Evaluation Branch conducts pilot-plant, small-systems, and distribution system studies. Data collected from all research activities within the Branch is computerized by this Section in a format that can be easily retrieved and used for comparative analyses. This Section also coordinates activities with other groups in the Division such as chemistry and microbiology to accomplish their functions.

Superfund Technology Demonstration Division

The Superfund Technology Demonstration Division plans, coordinates, and conducts national programs of research, development, demonstration, and test evaluation for the prevention, control, and abatement of multimedia pollution from releases of oils and hazardous materials and from leaking underground storage tanks.

Major program areas for this Division are: the management of the technical activities of the Superfund Innovative Technology Evaluation (SITE) Program that nurtures emerging technologies and demonstrates alternative and innovative technologies for clean-up of uncontrolled waste sites; the provision of the technical support to EPA Regional offices to enable Superfund decision-makers to select effective remediation and cleanup technologies for contaminated sites; the research and development of technologies to treat contaminated soils and debris; the development and evaluation of technologies for the prevention, leak detection, and corrective action of releases from storage tanks; the development of technologies that lead to improvement in the cost-effectiveness of cleanup operations at incidents involving releases of oil and hazardous materials; and the evaluation and improvement of exposure reduction technologies such as protective clothing, materials, equipment, and personnel hazard detectors.

The SITE Demonstration and Evaluation Branch manages the technical activities of the SITE program. The branch conducts the demonstration and emerging technology activities and assists the EPA program office in policy devel-

opment and demonstration, and thereby establish the commercial availability and use of innovative technology at Superfund sites. The goal is to ensure that a steady stream of technologies will be ready to be demonstrated in the fields, thereby increasing the number of viable alternatives for use in cleanup of Superfund sites.

The Demonstration Section conducts all phases of the demonstration and evaluation of innovative/alternative technologies under the SITE Program at the pilot or field level.

The Releases Control Branch conducts national programs of research, development, demonstration, test, and evaluation for the prevention, control, and abatement of multimedia pollution from releases of oils and hazardous materials; from leaking undeground storage tanks; from uncontrolled hazardous waste disposal sites; and from submerged, contaminated sediments. The Branch maintains a core of national and internationally recognized experts on spills, safety, and cleanup. The Branch develops and demonstrates the technology for mitigating the effects of pollution from these sources. This involves the evaluation of new and novel techniques for the cleanup of ecosystems damaged by spills, underground storage tank leaks, uncontrolled waste sites, and submerged contaminated sediments, and the contaminated wastes associated with clean-up operations. The Branch tests, evaluates, and develops robotics, personal protective clothing, and other safety equipment and procedures to protect personnel involved in the handling of pesticides and other toxic substances, as well as individuals engaged in emergency response activities at chemical spills and hazardous waste sites.

The Technical Support Branch provides engineering and scientific assistance to EPA Regional Offices, Program Offices, and others on the cleanup of hazardous wastes, particularly those associated with Superfund and Resource Conservation & Recovery Act of 1976 Corrective Action (RCRA CA) sites. The Technical Support Branch serves as the focal point within the RREL for such assistance, coordinating all Superfund and RCRA CA technical requests received by the Laboratory. The Branch draws upon experts in the Branch, in the Laboratory, or elsewhere (e.g., private consultants) to provide site-specific technical assistance and technology transfer functions to the Agency and others on Superfund problems. The Technical Support Branch provides and coordinates technical assistance on site-specific remediation problems through its Superfund Technical Assistance Response Team (START) Program and Engineering Technical Support Center (ETSC). Branch members or other Laboratory experts provide technical support on site remediation problems ranging from treatment technology screening; planning for remedial investigations/feasibility studies (e.g., site characterization treatment technology screening); development of Records of Decision (ROD); post-ROD treatment technology engineering designs; and implementation of remedial actions. Members of the Branch staff coordinate these ad-hoc, site-specific requests to determine which laboratory expert most appropriately should respond and to ensure that responses are practical and timely. Through the ETSC, the Branch also provides short-term, site-specific assistance to the Regional Offices on less complex remediation issues and technical assistance on general (i.e., nonsite-specific) Superfund remediation problems through technology transfer. The Branch produces reports, technical journal articles, and training, workshops, etc., which describe solutions to engineering problems encountered during Superfund site remediation. Lastly, the Branch serves as a repository of all treatability studies conducted on Superfund sites, evaluates this information, and disseminates its findings to those involved in site remediation.

The Waste Minimization, Destruction and Disposal Research Division

The Waste Minimization, Destruction and Disposal Research Division plans, coordinates, and conducts a program of multimedia research, development, and demonstration of new and improved methods for design, operation, and closure of facilities for management of municipal and hazardous waste residuals on land; municipal solid waste (MSW) resource recovery; the prevention, identification, control, and abatement of multimedia pollutants released from uncontrolled hazardous waste sites; the evaluation and development of thermal destruction devices as a means to destroy or detoxify hazardous waste materials; and the identification and evaluation of new methods to reduce waste generation.

The Municipal Solid Waste (MSW) and Residuals Management Branch (RMB) is responsible for research, development, demonstration, and evaluation of technologies for managing, treating, and land disposing of municipal waste, hazardous sludges, and residuals. Responsibilities also include remedial action technologies for uncontrolled waste sites. This includes improving design performance and evaluating control technologies for waste residuals as it relates to land disposal, storage and treatment facilities, and uncontrolled sites. Solidification/stabilization research concentrates on the evaluation of this technology for the treatment of waste residuals to eliminate or control pollutant release and for product utilization of the stabilized wastes. Alternatives for treatment and utilization of MSW combustion residues are also being evaluated. MSW research is emphasizing recycling and demonstration and evaluation of innovative techniques to manage MSW. Landfill research is concentrating on methods to improve waste stabilization and gas recovery. Technical information and new control methods and treatment/disposal facility evaluation techniques for waste residuals are provided through technical reports, contribution to scientific literature, technical assistance to other EPA components, to other Federal agencies, and to State and local governments.

The Pollution Prevention Research Branch is responsible for providing a technical foundation for encouraging the development and adoption of production, recycling, and treatment processes that result in the reduction of the volume or hazardous nature of wastes being generated. The branch is recognized as the primary contact within the RREL for technical support of programs related to the EPA's Pollution Prevention Program. As such, the Branch identifies and evaluates relevant production techniques and waste management technologies, designs and tests prototypes, performs model waste minimization assessments to public and private organizations on waste minimization topics and participates in relevant seminars and national and international technical meetings.

The Thermal Destruction Branch is responsible for programs to evaluate and develop thermal destruction processes as a means to destroy or detoxify hazardous and other waste materials. This includes providing an information base on design, operation, and performance characteristics for such devices so that they will be able to safely, reliably, and cost-effectively achieve target levels of destruction and removal efficiencies while minimizing the formation of products of incomplete combustion and adequately controlling the fate of metals contained in the wastes.

The Water and Hazardous Waste Treatment Division

The Water and Hazardous Waste Treatment Division is responsible for managing a national program of research, development, and demonstration through intramural and extramural activities to advance the state-of-the-art of treatment technologies and related systems designed to treat and destroy hazardous and toxic pollutants. The Division is also responsible for developing, compiling, and maintaining treatability databases that document the capability of state-of-the-art treatment technologies for use

by the private sector and government agencies in solving specific cleanup problems. Similarly, it provides systems-engineering analyses and expert systems for public use.

The Physical/Chemical Systems Branch is responsible for programs to evaluate and develop physical and chemical processes and technologies for the safe, reliable, and cost-effective treatment of hazardous and toxic wastes; and for studies to characterize and control emissions from hazardous and toxic waste management. In addition, the Branch is also responsible for control of municipal waste water pollution, including sludges, through more effective operation and maintenance of publicly-owned treatment facilities, inproved design of these facilities, and consideration of the total wastewater infrastructure, including the sewer system. Included are upgrading techniques, new technologies, small community and institutional treatment, reliability of treatment facilities, problems within the sewer system, and problems associated with urban runoff.

The Biosystems Branch is responsible for developing biological treatment methods for toxic and hazardous wastes and for controlling toxics and toxicity in wastewaters. The Branch determines the fate and develops fate models for new and existing toxic chemicals in bioremediation and in conventional biological treatment. It also develops the basic science and engineering related to biodegration mechanisms and pathways; characterizes the treatability of hazardous and toxic chemicals in aerobic, anaerobic, and fungal biosystems applied to hazardous wastes, oil spills, contaminated sites, and to industrial and municipal wastewaters. Toxicity reduction evaluation (TRE) procedures for wastewater treatment are developed and related industrial pretreatment assessments are conducted. The Biosystems Branch also characterizes the treatability of hazardous wastes and leachates in biological wastewater treatment plants (public-owned and industrial) and devlops techniques to improve control of toxics in wastewater treatment.

The Toxics Control Branch coordinates and conducts a national program of multimedia environmental protection research, development, and demonstration to provide control technologies for specific toxic chemicals and pesticides. The Branch is responsible for the development, implementation, and coordination of research programs to coordinate Office of Environmental Engineering and Technology Demonstration efforts, and where appropriate, develop and demonstrate cost-effective technologies to prevent, control, abate, and predict toxic or multimedia pollution from operations associated with industrial processes, manufacturing, use of chemicals and chemical products, including bioengineered organisms, abatement of asbestos, and pesticide disposal.

Unique Equipment, Facilities or Services

Incineration Research Facility
Ms. Marta K. Richards
(513) 569-7881

The Incineration Research Facility (IRF), located on the grounds of the National Center for Toxological Research in Jefferson, Arkansas is the EPA's principal in-house pilot-scale thermal destruction research facility and is fully RCRA permitted to conduct tests on the entire range of hazardous wastes normally encountered in the hazardous waste treatment industry. The mission of the IRF is to provide pilot-scale data relative to the thermal destruction of "real world" hazardous wastes. Combustion technologies can then be used to treat these wastes while protecting the environment and promoting public health and safety. The IRF is a government-owned/contractor-operated facility with extensive on-site capabilities for characterizing waste and evaluating process samples. The IRF, in its 12,000 square foot facility, houses two pilot-scale incineration systems, a bench-scale thermal treatability test unit, plus adjacent laboratories, offices, trailers, and outdoor support equipment. The two

pilot-scale research incinerators are a Liquid Injection System and a Rotary Kiln System. Each system incorporates primary and secondary combustors and associated waste handling equipment, including air control pollution devices. On-site sampling and analytical capabilities of the IRF include the ability to identify, extract, and analyze most of the pollutants listed in EPA protocols. The only exceptions are dioxins/furans. IRF equipment includes a HP Mass Detector and two HP 5880 Gas Chromatographs with Hall, Photoionization and Flame Ionization Detectors that are dedicated to the analysis of volatile organic compounds. The laboratory can also do wet chemistry associated with more traditional analytical methods. The IRF serves as the EPA's major source of performance data on waste destruction characteristics including current issues of combustion by-products and metal contaminant behavior.

CRADAs

1) Chapman, Inc.
Use of EPA's mobile in-situ soil containment technology for treating hazardous wastes

2) Cold Jet, Inc.
Evaluate dry ice particle blasting and other abatement processes for the removal of lead-based paint

3) Drysdale and Associates
Development and evaluation of automatic sensors and data acquistion equipment for drinking water treatment plants

4) James G. Brown Foundation, Inc. and Remediation Technologies, Inc. and U.S. Forest Service
Use of fungal technology to effectively biotreat soil contaminated with PCP and PAHs

5) Levine-Fricke, Inc.
Lab and pilot scale study of biodetoxification waste treatment technology for degrading solid, liquid, or gaseous waste from RCRA and CERCLA wastes

6) Lewis Publishers, Inc./CRC Press, Inc.
Development of a cost and performance model for safe drinking water cleanup technologies

7) Vulcan Iron Works, Inc.
Use of EPA's mobile incinerator for destruction of hazardous wastes

8) Water Quality Association
Evaluation of a home water softener on the corrosiveness of water

Environmental Protection Agency

Test and Evaluation Facility

U.S. EPA Test and Evaluation Facility
1600 Gest Street
Cincinnati, OH 45204
Mr. Francis L. Evans III
Phone: (513) 684-2626
FAX: (513) 684-2628

Lab Description

The Test and Evaluation (T&E) Facility provides the U.S. EPA's Cincinnati-based laboratories the capability to study the treatment of municipal and industrial pollutants. It also permits the EPA to work with private and public clients in the development of practical and innovative solutions to environmental problems of today and tomorrow. The T&E is designed to accommodate a changeable variety of bench- and pilot-scale studies.

Organizational Structure

The T&E Facility is administered through U.S. EPA's Risk Reduction Engineering Laboratory (RREL). The Facility is managed by a highly experienced technical team of the EPA, complemented by skilled management and technical support of the contractor for the Facility—IT Environmental Programs, Inc. (ITEP, formerly PEI Associates, Inc.) and ITEP's subcontractor, Miami University.

Individual Lab Description

The diverse research capabilities of EPA's T&E Facility are accessible to industry, academic institutions, and other government agencies for research and development studies. Under the provisions of state and federal permits held by the T&E Facility, a broad range of research and development activities for evaluating chemistry of pollutant destruction, pollution control devices, and hazardous waste treatment technologies can be performed. Outside clients may enter into cooperative research and development agreements with EPA or use ITEP's contract services.

Unique Equipment, Facilities or Services

The T&E Facility is a two-story, 33,000 sq. ft. building with a 24,000 sq. ft., high-bay experimental area. Facilities and services include analytical chemistry laboratories, chemical storage areas, liquid and solid hazardous waste storage facilities, liquid pumping systems, two 5-ton bridge cranes, automatic spill alarm and facility drainage shutdown system, greenhouse, machine shop, and offices. Large overhead doors can accommodate trailer/mobile units. Direct feed lines to each of 16 experimental bays from the adjacent Mill Creek Sewage Treatment Plant provide wastewater for research purposes. Each bay is also equipped with high and low pressure air, and electric power ducts (120V, 240V, and 480V). Other specific support equipment and services may be obtained and installed as needed.

The T&E Facility is permitted by the U.S. EPA and State of Ohio as a RCRA Treatment, Storage and Disposal Facility (TSDF) to accept a wide variety of hazardous wastes for numerous types of treatment studies. The T&E Facility also holds a State treatability exemption, which permits treatability studies using any technology for small quantities of all categories of hazardous wastes. The broad coverage provided by these permits makes it possible to perform in this Facility a range of waste treatment studies unmatched by any similar facility in the nation.

Unique Personnel Expertise

Staff located on-site monitor ongoing research studies seven days a week. Staffing includes project managers, operators, technicians, and skilled craftsmen as needed.

This staff may be supplemented by other scientists and engineers from EPA, ITEP, and Miami University.

Ongoing and Recently Completed Studies

Demonstration of Decontamination of Debris at Superfund Sites
N. Barkley, M. Dosani, and M. Taylor
803812-26

Vapor-Liquid Equilibrium Studies
F. Alvarez, M. Foerst, and E. R. Krishnan
803811-2

Biological Pretreatment of CERCLA Leachates Using Upflow Anaerobic Filters
R. Brenner, S. Krishnan, E. R. Krishnan, and R. C. Haught
803812-5

Comparison of Biological Pretreatment of CERCLA Leachates using GAC Anaerobic Fluidized Bed and Anaerobic Filter Followed by POTW Treatment
R. Brenner, M. Suidan, E. R. Krishnan, S. Krishnan, and R. Nath
803812-6

Leachate Treatment by GAC Fluidized Beds
R. Brenner, M. Suidan, R. Nath, E. R. Krishnan, and S. Krishnan
803811-7

Verification of Methods to Quantify Vector Attraction Reduction
J. Farrell, V. Bhide, R. Haught, and E. R. Krishnan
816012-033

Bioslurry Treatment Study
E. R. Krishnan, R. Lauch, and C. Chambers
803811-28/803811-35

Biodegradation of Crude Oil Sludge
M. Taylor, E. R. Krishnan, K. Brown, and R. C. Haught
W1011G-92

Development and Evaluation of Composting Techniques for Treatment of Soil Contaminated with Hazardous Wastes
M. Dosani, M. Rahman, J. Glaser, C. Potter, and E. R. Krishnan
803812-42

RBC Treatment of Leachates
E. Opatken
EPA Internal Project

White Rot Fungus Field Study
S. Safferman, P. Scarpino, E. R. Krishnan, and J. Platt
816012-004

Bench-Scale Wet Air Oxidation of Dilute Organic Wastes
D. Timberlake, E. R. Krishnan
803811-2

Degradation of PAH in Contaminated Soil by White Rot Fungus
S. Safferman, Roy C. Haught, E. R. Krishnan, and J. Platt
816012-004-01

New Package Plant Drinking Water Treatment Configuration for Small Systems
J. Goodrich, M. Dosani, and E.R. Krishnan
803812-025

Development of Aerobic Biofilter Design Criteria for Treating VOCs
R. Brenner, M. Suidan, G. Sorial, L. Smith, and P. Smith
EPA W.A. No.: 2-86

Treatability Study for Terpene
D. Perrin, M. Rahman, C. Hummel, F. Alvarez, R. Nath, and S. Krishnan
803812-17

Bioremediation in Superfund Landfills
S. Safferman, D. Perrin, J. Davis, and E.R. Krishnan
EPA W.A.# 3-97/803813-47

Engineering Optimization of Slurry Bioreactors for Treating Hazardous Waste in Soils and Sediments
J. Glaser, M. Dosani, J. Platt, P. McCauley, E.R. Krishnan

Comparative Testing of Emerging Surface Cleaning Systems for Lead Paint Removal from Various Substances
J. Burkle, R. Amick, and M. Zelinski

Environmental Protection Agency

Office of Technology Transfer

Environmental Protection Agency—
Office of Technology Transfer
Office of Research and Development
26 W. Martin Luther King Dr.
Cincinnati, OH 45268
Mr. Larry Fradkin
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Lab Description

This office has three primary functions: 1) managing the delivery of EPA Office of Research and Development products and services through technology transfer and technical information exchange; 2) the analysis and integration of scientific and technological information in the development of regulations; and 3) promoting the EPA Region's interests in research activities. Technology transfer staff are responsible for implementing provisions of the Federal Technology Transfer Act of 1986 and identifying innovative ways to channel research and development data to decision makers inside and outside the EPA. Many products are available in the form of documents or training manuals.

Individual Lab Descriptions

Technology transfer activities include transfering information on many of the following topics. The lab and research descriptions below are just a sample of the many research activities carried out by the EPA that are available through the Office of Technology Transfer.

- Hazardous Waste/Superfund Research

The Superfund Technology Demonstration Division of the EPA's Risk Reduction Engineering Laboratory plans, coordinates, and conducts national programs of research, development, demonstration, and test evaluation for the prevention, control, and abatement of multimedia pollution from releases of oils and hazardous materials and from leaking underground storage tanks

Major program areas for this Division are: the management of the technical activities of the Superfund Innovative Technology Evaluation (SITE) Program that nurtures emerging technologies and demonstrates alternative and innovative technologies for the cleanup of uncontrolled waste sites; the provision of the technical support to EPA Regional offices to enable Superfund decision-makers to select effective remediation and cleanup technologies for contaminated sites; the research and development of technologies to treat contaminated soils and debris; the development and evaluation of technologies for the prevention, leak detection, and corrective action of releases from storage tanks; the development of technologies that lead to improvement in the cost-effectiveness of cleanup operations at incidents involving releases of oil and hazardous materials; and the evaluation and improvement of exposure reduction technologies such as protective clothing, materials, equipment, and personnel hazard detectors.

- Water/Waste Water Research

Researchers at the EPA's Center for Bioengineering and Pollution Control at the University of Notre Dame have developed innovative methods of treating groundwaters and soils contaminated with such potentially hazardous compounds as benzene, toluene, ethylbenzene, and xylenes (BTEX), 2,4,6-trinitrotoluene (TNT), bis (2-ethylexyl) phthalate (BEHP), trichloroethylene (TCE), and petroleum based products (e.g., gasoline, jet fuel, and diesel fuel). Utilizing in situ and ex situ bioremediation, several studies

currently underway are moving towards field applications.

The following is a list of ongoing research subjects:

- Radiolytic destruction of organics
- Photolytic (UV/TiO2) destruction of organics
- Biofiltration: Biological degradation of VOCs in contaminated gas streams
- Characterization of soil biopolymers: pyrolysis/gas chromatography/mass spectrometry
- Bioventing: Providing oxygen for in situ bioremediation by augmentation of air flow
- Trichloroethylene (TCE) degradation by nitrifying bacteria
- Degradation of contaminated soils located in cold environments
- Halophilic bacteria degradation of organics in high salt concentration waste streams
- Control of fugitive emissions with the granular activated carbon-sequencing batch reactor (GAC-SBBR)
- Controlled release of oxygen sources for soil bioremediation applications
- Treatment of trichloroethylene in the sequencing batch biofilm reactor
- Combined biofilm and suspended growth sequencing batch reactors
- Treatment of polychlorinated compounds in the sequencing batch reactor
- Application of white rot fungus phanerochaete chrysosporium to contaminated soil
- Degradation of recalcitrant organics by phanerochaete chrysosporium
- Anaerobic sequencing batch reactor treatment of leachates
- Removal of nitrate from groundwater
- Bioremediation of soils contaminated by metals and radionuclides
- Use of UV irradiation to enhance fungal degradation of organopollutants
- Biological treatment of organopollutants using Aureobasidium pullulans
- Production of commercially important enzymes from Aureobasidium pullulans

- Solid Waste Research

At the Risk Reduction Engineering Laboratory in Cincinnati, the Waste Minimization, Destruction and Disposal Research Division plans, coordinates, and conducts a program of multimedia research, development, and demonstration of new and improved methods for design, operation, and closure of facilities for management of municipal and hazardous waste residuals on land; municipal solid waste (MSW) resource recovery; the prevention, identification, control, and abatement of multimedia pollutants released from uncontrolled hazardous waste sites; the evaluation and development of thermal destruction devices as a means to destroy or detoxify hazardous waste materials; and the identification and evaluation of new methods to reduce waste generation.

The Municipal Solid Waste and Residuals Management Branch of this Division is responsible for research, development, demonstration, and evaluation of technologies for managing, treating, and land disposing of municipal waste, hazardous sludges, and residuals. Responsibilities also include remedial action technologies for uncontrolled waste sites. This includes improving design performance and evaluating control technologies for waste residuals as it relates to land disposal, storage and treatment facilities, and uncontrolled sites. Solidification/stabilization research concentrates on the evaluation of this technology for the treatment of waste residuals to eliminate or control pollutant release and for product utilization of the stabilized wastes. Alternatives for treatment and utilization of MSW combustion residues are also being evaluated. MSW research is emphasizing recycling and demonstration and evaluation of innovative techniques to manage MSW. Landfill research is concentrating on methods to improve waste stabilization and gas recovery. Technical information and new control methods and treatment/disposal facility evaluation techniques for waste residuals are provided through technical reports, contribution to scientific literature, technical assistance to other EPA components, to other Federal agencies, and to State and local governments.

- Bioremediation

Biosystems use microorganism, such as bacteria or fungi, to transform harmful chemicals into less toxic or nontoxic compounds. To the microorganisms being used in a bioremediation program, the pollutants are an energy, or "food" source. They break down the pollutants in the course of getting the energy they need to live and multiply. Different organisms metabolize different chemicals. By using an organism that breaks down a particular pollutant, scientists can tailor the technology to the pollutants found at specific sites. Whenever possible, clean-up teams use native microorganisms in bioremediation efforts as these organisms are already metabolizing the pollutants on the site. In such situations, the number of microorganisms, and the speed at which the pollutants are broken down, can be increased by adding nutrients to the site. In other cases, non-native organisms that are known to metabolize the identified pollutant are introduced to the contaminated site.

Biotransformation such as this is an attractive option because it is "natural," and the residues from the process (such as carbon dioxide and water) are usually harmless. Other advantages include it being less expensive and disruptive than other options used to remediate hazardous waste, i.e. excavation and incineration. It also holds a clear advantage over technologies that rely on physical or chemical processes. Instead of merely transferring pollutants from one medium to another, bioremediation can destroy the targeted contaminant.

For example, in the wake of the Exxon Valdez tanker accident in March, 1989, a CRADA was signed by the EPA and Exxon Oil to initiate a bioremediation study in Prince William Sound, where over 900 miles of shoreline had been contaminated. In the span of two months from the time of the spill, EPA developed a research program for using bioremediation to degrade residual oil washed up on these beaches. Field tests began six days after the formal signing of the CRADA between Exxon and EPA. On designated beach sites, EPA scientists applied fertilizers to stimulate native organisms on the beach to degrade the spilled oil. Reference sites, with no fertilizer, were also established. The striking visual difference between test sites and reference sites focused national attention on the use of biosystems as treatment options for oil spills. Six weeks after testing began, large scale bioremediation efforts were underway. Eventually, over 70 miles of coastline were cleaned up in this manner. Under the CRADA, Exxon paid for all the costs of field operations directly applicable to the bioremediation study. To ensure the independence of study results, EPA paid and was responsible for oversight and management of the project as well as conducting the field work.

- Auto Emissions Testing

The purpose of the research conducted at the National Vehicle and Fuel Emissions Laboratory is to help reduce the harmful pollutants emitted from motor vehicles, including automobiles, trucks, motorcycles, buses, locomotives, and aircraft. For example, a CRADA has been issued to create a Low Level Exhaust Emissions Test Site. The purpose of this cooperative research program is to improve the quality of Low Level Exhaust Measurement Technology on chassis dynamometer test sites for conventional and alternate fueled vehicles (CNG, methanol, ethanol, diesel, etc.). The Environmental Research Consortium (ERC), the U.S. Environmental Protection Agency (EPA), and the California Air Resources Board (CARB) will analyze and evaluate state-of-the-art low level emissions measurement technology available or pending development. Major findings of the study will have implications for how emissions test calls are designed, built and operated in the U.S. "Low Level Emissions" are defined as emission levels as provided in California regulations for Transitional Low Emissions Vehicles (TLEV), Low Emissions Vehicles (LEV), Ultra Low Emission Vehicles (ULEV),

and EPA Tier II. Recommendations will be developed and a pilot will be initiated to test the practical application of the resulting recommendations. A stated goal is to standardize test equipment, diagnostics, and procedures such that equivalent test results can be achieved among all laboratories.

- Risk Assessment

The Environmental Criteria and Assessment Office - Cincinnati (ECAO-Cin) provides scientific leadership for assessing human health risks associated with exposure to environmental pollutants. ECAO is charged by the U.S. EPA to prepare human health-based risk assessments and methodologies for risk assessment. Many of the risk assessments are included in documents that address, but are not limited to, water and air pollution, solid and hazardous wastes for use in various regulatory activities, and related research on systemic toxicity and chemical mixtures. This office also has the responsibility for providing site-, situation-, and chemical-specific assessments covering single chemicals and complex exposures to the Program Offices and the Region. ECAO-Cin serves as a focal point for the collection, summarization, evaluation and assessment of all available data, from both national and international sources, concerning the toxic effects that may result from exposure to various environmental pollutants. To this end, it has developed the following databases:

MIXTOX Toxicologic Interaction Database

The MIXTOX information system is a self-contained software package for the IBM-compatible or Macintosh personal computer. Data presentation includes summaries of specific interaction evaluations as well as summaries across studies to pair. The data in MIXTOX are obtained from all available published studies on toxicologic interactions. The goal is to be complete, not merely representative. Exposure and toxicity are briefly described. The interaction is characterized by type and significance.

Integrated Risk Information System (IRIS)

IRIS is a database that summarizes human health risk assessment information on individual chemicals and substances. It currently contains information on approximately 500 substances, with approximately 50 new substances added each year. The primary information in IRIS includes inhalation reference concentrations (RfCs) and oral reference doses (RfDs) for noncarcinogenic effects, and carcinogenicity assessments. The carcinogenicity assessments include a weight-of-evidence for the substance's potential for human carcinogenicity and a quantitative risk estimate based upon slope factors.

- Aquatic Toxicity Research

The Environmental Research Laboratory at Duluth (ERL-D) conducts research to advance the fundamental understanding of aquatic toxicology and freshwater ecology. Its mission is to develop a scientific basis for EPA to create environmental policies concerning the use of freshwater resources. ERL-D is composed of five research branches and has field research stations at Grosse Ile, Michigan and Monticello, Minnesota. ERL-D is part of EPA's Office of Research and Development located in Washington, D.C.

Other current work in field of water quality and safety is performed by The Inorganics and Particulates Control Branch of the Drinking Water Division of the EPA's Risk Reduction Engineering Laboratory. This Branch conducts studies and evaluations of water treatment processes for the removal or control of inorganic and particulate contaminants, including radionuclides, in drinking water. The research programs conducted there focus on three categories of work; treatment technology for the removal of inorganic contaminants from drinking water with an emphasis on small systems; the control of inorganic contami-

nants associated with corrosion of distribution systems; and developing treatment technology for the removal of turbidity and other particulates from drinking water with an emphasis on small systems technology.

Unique Equipment, Facilities or Services

The EPA has established many clearinghouses, hotlines and electronic bulletin boards to respond to legislative initiatives and to provide outreach, communications and technology transfer. Access to these sources may provide answers to questions generated by EPA technology transfer issues. The following is a list of these clearinghouses, hotlines and electronic bulletin boards.

Alternative Treatment Technology Information Center (ATTIC) - provides information on alternative and innovative hazardous waste technologies
Modem: (301) 670-3813
Modem: (301) 670-3808

Clean-Up Information Bulletin Board System (CLU-IN) - provides information on Superfund response activities and hazardous waste corrective action.
Modem: (301) 589-8366
System Operator: (301) 589-8368

Clearinghouse for Inventories and Emission Factors (CHIEF) - provides air pollution emission factors for criteria and toxic pollutants from stationary and area sources, as well as mobile sources.
Modem: (919) 541-5742
Modem: (919) 541-1447
System Operator: (919) 541-5232

Hazardous Waste Ombudsman Program - provides information on hazardous and solid waste issues.
(800) 262-7937
(301) 260-9361
(301) 260-1482

Office of Research and Development Electronic Bulletin Board System (ORD BBS) - provides an on-line, text-searchable database of ORD publications and offers a message exchange, bulletins, public domain files, on-line registration for ORD meetings, and special conferences.
Modem: (513) 569-7610
System Operator: (513) 569-7502

ORD Publications - answers phone and mail request for ORD publications and research information.
(513) 569-7562

Pollution Prevention Information Clearinghouse (PPIC) - provides information to aid in reducing or eliminating discharges and emissions through source reduction and environmentally sound recycling
Clearinghouse: (703) 821-4800

Pollution Prevention Information Exchange System (PPIES) - offers computerized access to databases and document ordering.
Modem: (703) 506-1025

Resource Conservation and Recovery Act/Superfund/UST Hotline - provides assistance in understanding EPA's regulations pursuant to RCRA, Underground Storage Tanks — USTs, Superfund/CERCLA, Pollution Prevention/Waste Minimization.
(800) 424-9346
(703) 920-9810

Safe Drinking Water Hotline - provides information on public water supply program, policy, technical and regulatory issues.
(800) 426-4791

Small Business Ombudsman Clearinghouse/Hotline - provides information and assistance on asbestos, hazardous waste, air and water relevant to small business to enhance voluntary compliance with regulations.
(703) 305-0204
(800) 368-5888

Solid Waste Information Clearinghouse and Hotline (SWICH) - collects and distributes information on solid and municipal waste systems.
Modem: (301) 585-0204
Modem: (800) 677-9424

Patents

While the scope of this catalog is limited to laboratories and facilities in the FLC's Midwest Region, the Cincinnati EPA Office of Technology Transfer provides assistance in technology transfer activities that access all available EPA technologies, process, etc. from EPA facilities across the nation. To date, 5 licensing agreements have been reached with EPA laboratories/ facilities and businesses. The patents/licensing agreements listed below are grouped together by their respective EPA lab/facility partner.

Air and Energy Engineering Research Laboratory - Research Triangle Park, NC

ABB FLAKT, Inc./University of Texas - Licensing of absorbants for air pollution control technology.

GenLime Corp. - Licensing of Limestone Injection Multistage Burner process for reducing sulfur emission from coal plants.

Risk Reduction Engineering Laboratory - Cincinnati, OH

Boyle Engineering, Inc. - Licensing of EPA patent on butylamine group-containing ion exchange resins for water purification.

Office of Environmental Processes and Effects Research - Environmental Research Lab - Athens, GA

Bio-Rad Laboratories, Inc. - Licensing of method for interfacing between a liquid chromatograph and a mass spectrometer for conditioning liquid stream from the chromatograph to the spectrometer.

Office of Environmental Processes and Effects Research - Environmental Research Lab - Gulf Breeze, FL

SBP Technologies, Inc. - Licensing of two EPA-patents on biological remediation of creosote- and similarly-contaminated soil and ground water.

CRADAS

The Cincinnati EPA Office of Technology Transfer provides assistance in technology transfer activities that access all available EPA technologies, process, etc. from EPA facilities across the nation. To date, 44 CRADAs have been reached with EPA laboratories/ facilities and businesses. The CRADAs listed below are grouped together by their respective EPA lab/facility partner.

Office of Research and Development - Headquarters

Exxon Corporation, USA - Development and demonstration of the feasability of accelerating the rate of biodegradation of oil spill residues on Alaskan shores.

Air and Energy Engineering Research Laboratory - Research Triangle Park, NC

ABB FLAKT, Inc. - Licensing of absorbants for air pollution control technology.

Aladdin Steel Products, Inc. - Further the development and commercialization of an EPA-patent for gas-enhanced woodstove technology for reducing emissions into the atmosphere.

Nalco Fuel Tech, L.P. - Determining the sulfur dioxide and nitrogen removal efficiency by the EPA-patented calcium-based and urea-based sorbents.

Nalco Fuel Tech, L.P. - Development of a combination Selective Catalytic Reduction/ Selective Non-Catalytic Reduction process for nitrogen oxides emissions in combustion effluent.

Risk Reduction Engineering Laboratory - Cincinnati, Ohio

Chapman, Inc. - Use of EPA's mobile in-situ soil containment technology for treating hazardous wastes.

Clean Sites, Inc. and USAF (in conjunction with OSWER/TIO) - Commercializing innovative treatment technologies for

contaminated soils and ground water at McClellan AFB, Sacramento, CA.

Cold Jet, Inc. - Evaluate dry ice particle blasting and other abatement processes for the removal of lead-based paint.

Drysdale and Associates - Development and evaluation of automatic sensors and data acquisition equipment for drinking water treatment plants.

James G. Brown Foundation, Inc. and Remediation Technologies, Inc. and U.S. Forest Service - Use of fungal technology to effectively biotreat soil contaminated with PCP and PAHs.

Levine-Fricke, Inc. - Lab and pilot scale study of biodetoxification waste treatment technology for degrading solid, liquid, or gaseous waste from RCRA and CERCLA wastes.

Lewis Publishers, Inc./CRC Press, Inc. - Development of a cost and performance model for safe drinking water cleanup technologies.

Shell Oil (in conjunction with OSWER/OUST) - Field evaluation of vacuum extraction technology for underground storage tanks (USTs).

Vulcan Iron Works, Inc. - Use of EPA's mobile incinerator for destruction of hazardous wastes.

Water Quality Association - Evaluation of a home water softener on the corrosiveness of water.

Office of Environmental Processes and Effects Research - Environmental Research Lab - Corvallis, OR

Niagara Mohawk Power Company - Use of a Biological Earthworm Assay to evaluate the efficiency of a thermal desorption technique.

Office of Environmental Processes and Effects Research - Environmental Research Lab - Gulf Breeze, FL

Electric Power Research Institute - Identification of a bioremediation technique to remediate mercury contaminated freshwater environments.

Southern Bioproducts, Inc. - Development of microbiol isolates to degrade toxic chemicals.

Southern Bioproducts, Inc. - Performance of research on bioremediation of wood treatment waste sites.

Office of Environmental Processes and Effects Research - R.S. Kerr Environmental Research Lab - Ada, OK

Coastal Remediation Company - Bioremediation process developed to remove alkylbenzene contamination through the injection into the subsurface of a nutrient mix.

Health Effects Research Laboratory - Research Triangle Park, NC

E.I. DuPont de Nemours and Company - Visual function testing of a mixture of aliphatic dibasic esters.

Pathology Associates, Inc. - Use of the SENCAR Mouse Assay for indentifying complex mixtures in drinking water treatment plants.

Spiral Systems, Inc. - Development and utilization of automated and semi-automated microbial mutagenicity assays.

Atmospheric Research and Exposure Assessment Laboratory - Research Triangle Park, NC

Autoclave Engineers, Inc. - Development and/or improve ment of methods that use programmable pyrolysis for the analysis of trace organic species that occur in a condensed or other phase in the atmospheric environment.

Dow Corning Corporation - Investigation of environmental effects on damage to coatings and sealants used on automotive products.

Ford Motor Company - Use of EPA's Environmental Chamber Facility for evaluating effects of environmental fallout on automotive products.

Frandon Enterprises, Inc. - Development of a test kit method for lead.

Georgia Institute of Technology - Hydraulic model study for improved ocean outfall design at Boston Harbor.

NuTech Corporation - Design, development, production and testing of automated gas chromatographic injection equipment to determine organic compounds in ambient air.

Perkin-Elmer Corporation - Development and improvement of physical and chemical methods for trace contaminant analysis, automated canisters sampling for gaseous contaminants, and diffusion monitoring technologies.

Rohm & Haas Company - Paint substrate exposure study using covering-spray devices.

US CAR Environmental Research Consortium (Ford, GM, Chrysler, Navistar) and State of California - Develop new technology to identify evaporative emissions and hard-to-detect low-level exhaust emissions from cars and trucks.

Environmental Monitoring Systems Laboratory - Cincinnati, OH

American Water Works Association Research Foundation - Biotechnology and tissue culture methods for monitoring viruses in ground water.

Fisher-Scientific Company and R.T. Corporation - Research and development of solid matrix quality control samples.

NSI Technologies, Inc. - Research and development of liquid organic standards and preparation, verification, distribution, and stability of these samples.

Perkin-Elmer Corporation - Development of sampling methods for the PCR technology

Spex, Inc. - Research and development of inorganic reference materials and preparation, verification, distribution, and stability of these samples.

Supelco, Inc. - Research and development of liquid organic standards and preparation, verification, distribution, and stability of these samples.

Ultra Scientific, Inc. - Research and development of organic reference materials and preparation, verification, distribution, and stability of these samples.

Environmental Monitoring Systems Laboratory - Las Vegas, NV

Dow Corning Corporation - Use of EPA's Indoor Air Chamber to test a Dow-developed instrument.

Fiber Chem, Inc. - Development of fiber optic chemical sensors.

Hewlett- Packard Company - development of advanced laboratory instrumentation for exposure analysis.

Office of Ground Water and Drinking Water

CH2M Hill Southeast, Inc. - Use of EPA mobile packed column air stripping technology for treating drinking water contaminants.

Office of Solid Waste and Emergency Response - Office of Underground Storage Tanks

Shell Oil (in conjunction with RREL) - Field evaluation of vacuum extraction technology for underground storage tanks (USTs).

Office of Solid Waste and Emergency Response - Technology Innovation Office

Clean Sites, Inc. and USAF (in conjunction with RREL) - Commercializing innovative treatment technologies for contaminated soils and ground water at McClellan AFB, Sacremento, CA.

Health and Human Services

National Institute for Occupational Safety & Health

National Institute for Occupational Safety and Health
4676 Columbia Parkway
DPSE-R2
Cincinnati, OH 45226
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Lab Description

The NIOSH mission is to conduct research and provide training to assure a safe and healthful workplace for every man and woman. NIOSH has the authority to conduct research and make recommendations for the prevention of work related illness and injuries. A part of the Centers for Disease Control and Prevention (CDC), the Institute consults with the Department of Labor (DOL) and other federal, state, and local government agencies and with private industry to promote occupational safety and health. NIOSH evaluates hazards in the workplace ranging from chemical to machinery and investigates potentially hazardous working conditions as requested by employers and employees.

NIOSH activities are organized into four program strategies: identification, evaluation, control and dissemination. To identify or eliminate occupational health or safety hazards, the Institute enlists its own and other governmental agencies to gather data and also responds to industry requests for investigations of working conditions. NIOSH evaluates the cause and severity of work-related health problems through targeted laboratory and field research.

The Institute aims to control work related diseases and injuries by discovering, assessing and improving measures that can reduce occupational hazards. NIOSH research is directed towards: conducting research and providing scientifically valid recommendations for protecting workers; investigating potentially hazardous working conditions as requested by employers or employees; evaluating hazards in the workplace, ranging from chemicals to machinery; creating and disseminating methods for preventing disease, injury and disability; and providing education and training to individuals preparing for or actively working in the field of occupational safety and health.

Organizational Structure

The Office of the Director for the Institute is supported by the Office of Program Planning and Evaluation; the Office of Administrative and Management Services; and the Grants Program Activity, all located in the CDC facility in Atlanta, GA; and by a liaison office in Washington, D.C. The Institute has seven research divisions, two in Morgantown, West Virginia, and five in Cincinnati, Ohio.

Individual Program Descriptions

Division of Biomedical and Behavioral Science (DBBS)

DBBS conducts research via both laboratory and worksite investigations focused on toxicology, stress, ergonomics, and the effects of physical agents.

Division of Physical Sciences and Engineering (DPSE)

DPSE conducts worksite and laboratory research to develop procedures and equipment for the control and measurement of occupational health hazards. It also provides analytical support for the Institute's research efforts and operates a quality control reference program for industrial hygiene laboratories. This Division, located in Cincinnati, has developed new ventilation systems for sanders, automated routers, multiple-

opening presses and disc sanders. These new ventilation systems reduce emissions, do not interfere with the operator, require no special maintenance, are economically feasible, and, most importantly, work effectively.

Division of Respiratory Diseases Studies (DRDS)
The division designs, conducts, and interprets cross-sectional and prospective morbidity and mortality studies of occupational respiratory disease.

Division of Safety Research (DSR)
DSR is responsible for the safety research program aimed at preventing traumatic injury and death. DSR conducts laboratory and worksite studies to establish methods for minimizing workers' risk to injury and disease. These methods include the use of personal protective equipment, work practices, managerial approaches, and engineering controls.

Division of Standards Development and Technology Transfer (DSDTT)
DSDTT serves as the focal point for the development and review of scientific policy in the Institute. DSDTT develops and maintains a system of current information profiles that identify the number of potentially exposed workers, manufacturing production volumes, toxicity and severity of the hazard, and the status of research studies in federal agencies and the private sector.

Division of Surveillance, Hazard Evaluations, and Field Studies (DSHEFS)
DSHEFS conducts surveillance of the nation's work force and its environs to make an early detection and continuous assessment of the magnitude and extent of job-related illnesses, exposures, and hazardous agents. The objective of the industry-wide studies program is to conduct occupational health studies, the results of which are used to help make recommendations regarding safe levels of exposure in the workplace.

Division of Training and Manpower Development (DTMD)
The division develops continuing education programs to maintain and improve the competence of the occupational health and safety professional and paraprofessional work force.

Unique Equipment, Facilities or Services
NIOSH disseminates its research through Criteria Documents, Current Intelligence Bulletins, *The NIOSH Manual of Analytical Methods*, control technology assessments, hazard alerts, fact sheets, research reports, and articles in scientific journals and the CDC publication, *Morbidity and Mortality Weekly Report*.

Patents for License

Rapid and Simple Method of Detecting Isocyanate
R. F. Streicher
Serial No. 08/059,810
Filed 5/10/93

Adsorption System for Scavenging Anesthetic Agents from Waste Gas Release During Surgical Activity
Joseph E. Burkhart
Patent No. 5,044,363

Specific Irreversible Antagonism of Histamine Receptors by Photoaffinity Actuated Compounds
Jeffrey S. Fedan, et.al.
Patent No. 4,357,341

Variable Airflow Eddy Control
Keith G. Crouch
Patent No. 5,027,694

Variable Airflow Eddy Control
Keith G. Crouch
Patent No. 5,176,566

Auxiliary Control Technology for Routers
Vladimir Hampl, et.al.
Patent No. 4,986,703

Prevention of the Acute Cytotoxicity Associated with Silica-Containing Minerals
Val Vallythan, et.al.
Patent No. 5,096,733

Thin Film Environmental Monitor
G. Edward Burroughs, et.al.
Patent No. 5,055,267

Auxiliary Dust Control for Disc Sanders
Vladimir Hampl, et.al.
Patent No. 5,099,616

Auxiliary Dust Control for Rotational Hand Sanders
Valdimir Hampl, et.al.
Patent No. 5,105,585

Compact Drill Sampler for Quantitation of Microorganisms in Wood
Jacek Dutkiewicz, et.al.
Patent No. 5,073,553

National Aeronautics and Space Administration

Center for Commercial Development of Space on Materials for Space Structures

Center for Commercial Development of Space on Materials for Space Structures
Case Western Reserve University
10900 Euclid Avenue, White Building 219
Cleveland, OH 44106-7202
Ms. Sherry Jones
Phone: (216) 368-6215
FAX: (216) 368-6329

Lab Description

The primary goal of CMSS is to provide materials for space structures that are capable of being processed in space and capable of withstanding the space environment. The materials are being developed to have low density, plus high strength and stiffness - properties that are also applicable for Earth-based uses. As a result, CMSS is in a unique position to take a leadership role in the commericalization of these materials, not only for their intended use in space, but also for their commercial use on Earth. Research within the CMSS has two main thrust areas: organic and inorganic composites, and organic and inorganic coatings.

Individual Lab Descriptions

Organic and Inorganic Coatings

Protective coatings are needed for solar array materials (Kapton, silver, and organic structural composites), since these materials degrade on exposure to atomic oxygen in the low Earth orbit (LEO) environment. Some polymer coatings with a high inorganic content also degrade on exposure to atomic oxygen.

CWRU researchers are examining self-healing organic coatings, which show no weight loss after exposure to atomic oxygen generated in a radio-frequency asher. Under electron microscopy, the surface of coated Kapton samples showed no weight loss under an equivalent ten-year LEO exposure.

Silver/aluminum metal materials and silicon carbide coatings also are under study. The metallic coating provides reflectivity as well as resistance to damage and is applied by sputtering. The silicon carbide is applied by means of a plasma arc.

These coatings are being developed cooperatively by NASA Lewis Research Center and CWRU. The coatings are applied at CWRU and tested at both CWRU and NASA Lewis Research Center.

Organic and Inorganic Composites

Experimental polymer, metallic, and ceramic composites are under investigation for use in large structures in the space environment. Research includes processing, testing, and characterization of these materials, which have the specific requirements of a lifetime of at least 30 years and resistance to environmental and mechanical attack in LEO. Structural design issues include mechanical considerations, thermal cycling, space environmental effects, impact of micrometeorites, manufacturing processes, and cost.

Mechanical properties of interest to structures such as the space station include specific stiffness, specific strength, fracture mechanisms, and fatigue. Thermal considerations include coefficient of thermal expansion (CTE), microcracking, conductivity, and absorbance and emittance of the surface. CTE becomes particularly important because of the temperature cycling in LEO. One result of thermal cycling may be microcracking due to the difference in the CTE between adjoining materials.

CMSS is addressing these issues by performing advanced mechanical and thermal testing of experimental composites. In-situ observation of crack propagation and delamination studies under high-magnification scanning electron microscopy have become feasible with the deformation stage. Dynamic mechanical analysis is done on experimental materials before and after exposure to simulated space environments. Composites that hold most promise are included in the payload plans for exposure to the real LEO environment.

Additional areas of importance concern the long-term response of materials to LEO. Potential problems include outgassing of water and volatile species from structures; this may lead to dimensional instability or contamination of sensitive optical surfaces. CMSS has an ASTM E-595-84 controlled volatility testing unit and performs the test on a regular basis in conjunction with the flight program.

Evaluation of the effects of exposure to ultraviolet radiation, atomic oxygen, and the combination of the two, is part of CMSS's integrated research/analysis/flight activity on composites.

Unique Equipment, Facilities or Services

- ***The CMSS Program***

CMSS offers its industrial sponsors intensive research and development in the materials areas; analytical services, including the use of a simulated space environment; and access to NASA space flights for testing specimens.

Sponsors can take advantage of any one component of this program or the entire, coordinated package.

Research on development activities focus on creating and evaluating materials that can be used in space structures and developing materials for commercial use. Analysis with state-of-the-art instrumentation is performed before and after space-flight and simulated-space experiments, and on an ongoing basis for materials in the research and development program. The simulated space environment offers an opportunity to gain valuable information from a ground-based experiment before designing the flight experiment. Space flights are, however, available. Sponsors' material specimens can be tested with various exposures to the space environment.

Analysis and Space Simulation

With the broad range of state-of-the-art instruments in its Terrestrial Laboratory, CMSS offers industrial sponsors highly sensitive analyses of material specimens, both to augment sponsors' in-house development activities and to accurately determine the effects of the space environment on materials. The CMSS space simulation facility offers the opportunity to evaluate and qualify candidate materials for space flights.

Instrumentation within the CMSS Terrestrial Laboratory is briefly discussed below, followed by major CWRU facilities that are available to CMSS personnel.

- ***CMSS Terrestrial Laboratory***

Scanning Acoustic Microscope

The scanning acoustic microscope (SAM) is unique in its ability to perform nondestructive evaluation of the interior of opaque materials. It can be used, for example, to safely examine subsurface structures and elastic properties on a microscopic scale.

The Center's UH3SAM, manufactured by Olympus Corporation, is used to examine the connections and contact areas of strain gages, actinometers, and other instruments used in low Earth orbit experiments, to ensure that these interfaces maintain their integrity and provide optimal information during flight. The Sam is also used to investigate internal damage to composites caused by impacts, thermal cycling, or stress concentrators; and to examine defects underneath coatings and changes.

Scanning Electron Microscope

The scanning electron microscope (SEM) is used to study

surfaces exposed to a reactive environment. It is particularly useful for studying the topography of coatings, deposits, and corrosion layers; evaluating the impact of submicron particles on the surface of specimens; determining the composition of the impacting particle; and examining the development of a damage zone or cracks.

With the SEM, a JEOL 840A, surfaces of polymeric materials can be examined without applying a coating. A deformation stage attachment permits in-situ deformation studies of compression or tension specimens. An energy dispersive x-ray analysis attachment (EDAX) provides semi-quantitative analyses of elements and a light-element window provides detection of elements as light as boron.

Controlled Volatility Testing Unit

The controlled volatility testing unit is used to assure that materials taken into the space environment comply with ASTM E-595-84 specifications that limit the amount of volatiles released under vacuum (in order to minimize the contamination of optical and thermal control surfaces).

The controlled volatility test is carried out in a dedicated facility with controlled temperature and humidity. The system was supplied by McGhan NuSil Corporation.

Variable Angle Spectroscopic Ellipsometer

The variable angle spectroscopic ellipsometer (VASE) is extensively used to study oxidation, surface texture changes, and contamination - all processes that occur during exposure of materials to LEO.

With the VASE, manufactured by J.A. Woollam Company, the thickness of multilayer films in the submicron region can be accurately measured. This optical technique is nondestructive and noncontract.

Fourier Transform Infrared Spectrometer

The Fourier transform infrared spectrometer (FTIR) is primarily used to characterize the mechanisms by which the space environment degrades materials. This instrument is used to determine the composition of a wide range of materials - from thin polymeric films to thick, rough composites. The FTIR performs both qualitative and quantitative analyses, and provides information on the crystallinity, chemical composition, and orientation of the molecules in a specimen.

The Center's Nicolet 800 spectrometer represents the state-of-the-art in infrared spectroscopy. This instrument supports infrared microspectroscopy, RT-Raman, gas chromatography, and fiber optics interface. Attenuated total reflection and photoacoustic spectroscopy can also be performed.

Plasma Ashers

Plasma ashers are used to simulate LEO atomic oxygen, which is quite complex and difficult to create. The ashers produce an environment that is generally close enough to LEO to be useful for screening materials for failure mechanism and for testing protective coatings.

Cleanroom Facility

Specimens are stored and analyzed before and after exposure in a class-1000 cleanroom (per Federal Standard 209D). Class-100 areas are available for specific operations.

After the specimens have been weighed, photographed, physically measured, and monitored, they are integrated into the flight hardware and transported to a designated NASA flight center.

The specimens are put through an identical procedure after flight and are then returned to the sponsor.

- ***CWRU Facilities***

CWRU's extensive facilities are available to CMSS personnel, and in particular, the facilities of the departments of Macromolecular Science and Materials Science and Engineering. Selected capabilities are briefly discussed below.

Computer-interfaced model 1125 Instron machines are used for tension, compression, and cyclic loading tests conducted over a range of temperatures; a model 1361 Instron permits testing at very slow loading rates. Computer-interfaced servo-hydraulic MTS mechanical testing machines are used for cyclic testing at controlled load or strain amplitudes at frequencies from 0.01 to 60 Hz. Flexural fatigue machines are suited for high frequency fatigue tests exceeding 10^6 cycles.

The miniature material tester, a small deformation stage installed on an optical microscope, is used to study crack propagation and failure in tensile specimens in situ while the specimens are observed under the microscope.

The dynamic mechanical thermal anlyzer (DMTA) and the dielectric thermal analyzer (DETA) detect transitions and relaxations in polymeric materials over a wide temperature range. These instruments are used to measure for example, the miscibility of individual polymers in the blend, blend compatibility, cure of high-performance composites, and melting characteristics.

Differential scanning calorimetry (DSC) and thermo-gravimetric analysis (TGA) are thermoanalytical techniques used to measure temperature, weight change, and heat flow related to transitions in materials, as a function of time and temperature.

Acoustic emission analysis (AE) is a sensitive method of detecting acoustic signals and relating them to deformation and failure processes in materials.

Electronic spectroscopy for chemical analysis (ESCA), also known as x-ray photoelectron spectroscopy (XPS), is a highly sensitive surface analysis technique that provides detailed elemental and chemical information on the outer few atomic layers of a specimen.

Transmission electron microscopy (TEM) is used for high-resolution studies. A scanning transmission electron microscopy (STEM) provides capability for microchemical analysis of all elements heavier than boron. It is equipped with x-ray energy dispersive spectrometry (EDS) and electron energy loss spectrometry (EELS).

Specimen preparation facilities consist of dimplers, ion-beam thinners, and electropolishing units for specimen thinning. A microprocessor-controlled microtome is used to cut ultrathin - 0.005mm-sections.

- ***Space Flight***

CMSS offers its industrial sponsors the opportunity to test the performance of materials in space, on a limited, cost-share basis. The combination of analytical and empirical testing of candidate materials - before design decisions are finalized - makes possible the optimal selection of a structural material.

This program provides engineering and scientific services to U.S. firms developing space systems and also exposes CMSS-developed candidate materials to space environments representative of in-service conditions. Performance assessments will help in predicting the long-range performance of candidate materials.

While the goal of the space flight program is to provide environmentally stable structural materials to support the continued humanization and commercialization of the space frontier, the program also provides information on environmental stability through space exposure, evaluation, documentation, and in most cases, subsequent return of the candidate material to the supplier for internal investigation.

This approach will yield data to support or analytically verify the following:

- Materials application and selection for space service
- Database generation
- Follow-up on performance for materials acceptance
- Control systems designed for monitoring and for protection from environmental degradation
- Contributions to the understanding of the mechanisms and processes involved with

degradation of materials in space.

This approach also offers unique possibilities for exposure of candidate materials to space environments at a low cost, shared among sponsors.

Low-cost exposure of candidate materials is obtained by capitalizing on simple reusable fixtures on existing and planned space systems. Long-term scheduling further reduces the cost of verifying the performance of the materials and also minimizes both the outlay of funds and the risk to the sponsor of candidate material.

The maintenance of a technological edge in space requires space structural materials that maintain their integrity and environmental stability. Candidate structural materials should also have multiple applications and should be easily maintained throughout their projected service life. The key to the commercial potential is the ability of the developed structural materials to withstand the attack of space environments.

Unique Personnel Expertise

Dr. Eric Baer, Director
Organic Coatings and Composites

Dr. John F. Wallace, Co-Director
Inorganic Coatings and Composites

Dr. Anne Hiltner, Director of Terrestrial Laboratories
Organic Composites

Dr. John J. Lewandowski, Project Director
Inorganic Composites

Dr. Morton Litt, Project Director
Organic Coatings

National Aeronautics and Space Administration

Center for Mapping

Center for Mapping
National Aeronautics and Space Administration
The Ohio State University
Columbus, OH 43212
Dr. John D. Bossler, Director
Phone: (614) 292-1600
FAX: (614) 292-8062

Lab Description

The mission for the Center for Mapping is to provide focus, direction and leadership to the community involved in the science and technology of mapping applications, conduct interdisciplinary research and provide educational opportunities in the areas of the earth and space sciences. The Center's goals are to:

- Foster The Ohio State University's strength in earth and space sciences;
- Conduct research on the most challenging technical problems in mapping;
- Develop the framework for interdisciplinary programs of graduate studies, research and service within the University in the field of mapping;
- Facilitate discussion and cooperation among academia, industry and government agencies, both domestic and foreign, involved in mapping;
- Work cooperatively with the State of Ohio in the development of a prototype program for the modernization of land information systems;
- Provide an advisory service, continuing education, training programs and interdisciplinary seminars for public officials, land information managers, scientists and private users of mapping data;
- Reach out to engineering and science oriented college and high school students and encourage them to investigate opportunities in mapping and further their knowledge of the field.

Organizational Structure

The Center has three components: Geographical Information Systems Research, Computing and Cartographic Services, and Real Time Satellite Mapping Research. A Management Advisory Committee provides feedback to the Director on the Center for the Commercial Development of Space on Real Time Satellite Mapping Research.

Center for the Commercial Development of Space

The goals of NASA's Center for the Commercial Development of Space (CCDS) program are to encourage industry to consider space as an alternative to conventional research and development methods, and promote the commercialization of space through cost-effective transportation and infrastructure. There are 230 industry and university partners participating in the CCDS program through 17 of these Centers which are located across the country.

The Ohio State University CCDS at the Center for Mapping focuses on Real-Time Satellite Mapping which makes use of data as soon as it is transmitted from satellites. Its mission is to develop innovative commercial products for the mapping, remote sensing and geographic information system user communities.

This is accomplished by the timely collection of data that accurately locates surface features by geographic coordinates, merging these data collected by various means and different sources, converting these data to useful information through application and process models and providing the derived information to individuals and organizations in most need of the information.

More than 60 members of the Ohio State faculty with expertise in mapping are available to help research activities associ-

ated with the Commercial Center. These faculty members represent the departments of Agricultural Economics, Agricultural Engineering, Agronomy, Biology, Civil Engineering, Computer and Information Sciences, Geodetic Science and Surveying, Geography, Landscape Architecture, Management and Information Sciences, and Natural Resources to name a few.

The Ohio State University Center for the Commercial Development of Space is funded by NASA, private industry funding and university contributions.

Unique Equipment, Facilities or Services

Public Service

The Center reaches out to the university and the community by providing assistance and expertise in the field of mapping. Professional staff members train and assist users in the specialized equipment at the Center. The Center also hosts vendor demonstrations of the latest GIS products.

The Center for Mapping took the lead in facilitating the formation of the Ohio Geographically Referenced Information Program (OGRIP), and in 1987 Governor Celeste requested the Director of the Ohio Department of Administrative Services to coordinate a statewide effort in acquiring, managing and disseminating spatially referenced digital data. OGRIP responds to a critical need of local and regional governments, state agencies and private sector organizations by coordinating the efficient collection, management and use of geographically referenced digital information in order to improve public services throughout Ohio. The OGRIP Council is comprised of twenty Ohio public and private organizations. Together, these organizations are committed to enhancing economic development and cost efficiency throughout the state and local government in cooperation with the private sector.

In 1991, the Center became the official Ohio State repository and distribution point for U.S. Census Bureau's TIGER digital data for all 1990 census features (such as roads, railroads, and rivers) for the entire United States and its territories. The Center also houses demographic data for Ohio and Indiana with population and housing statistics.

The Center offers continuing education workshops and seminars for professionals, faculty and students which feature distinguished speakers. Faculty involvement in planning the seminar series and hosting the visitors has brought together mapping faculty who would otherwise rarely meet one another, developing relationships important to interdisciplinary research efforts.

The computer facilities at the Center for Mapping support instruction, research and demonstration in geographic information systems (GIS), mapping, remote sensing and related areas. The Center's staff of programmers and systems analysts are available for consultation and scanning and plotting services.

Computer Facilities

Vax 8530 Superminicomputer
80 megabytes of main memory
3.4 gigabytes of magnetic disk storage
1600/6250 tape drive
Languages: FORTRAN, C, Lisp Communications;
DECnet, TCP/IP, Kermit
Craystation: Direct connect to Ohio Supercomputer
ARC/INFO: ESRI's Geographic Information System
LAS: NASA's Land Analysis System
ERDAS: Integrated Image Processing/GIS

Workstation and PC-based GIS / mapping / remote sensing systems
ERDAS: Integrated image processing/GIS (486-PC and Sun)
Integraph: Map/image input, processing and analysis and output (3055 and 6040 base)
Integraph Software: Microstation 32 and PC, I/RASB, SRIF, I/RASC, I/SCAN
I/Plot, MGE, I/VEC, ModelView, I/Class. InRoads, Informix, MGE Projection Manager
MIPS: Map and Image Processing System (386-PC)

GRASS: Geographic information and image processing (MacIIX and Sun)
GeoVision: Automated Mapping/GIS (Sun 4/75GX)
AUTOCAD 11 (386-PC and SUN)
GEO/SQL 3.1 (386-PC and SUN)
SPANS (386-PC)
IMAGE (Image Processing on Macintosh)
Map Box (Decision Images) (386-PC)

Input and Output Devices
Versatec 8936 color electrostatic plotter (E-size)
Optronics 5040 high-resolution optical scanner (up to 40" by 50")
Montage FR1 35mm film recorder
Calcomp 5602 color thermal plotter (A-size)
Calcomp 9100 digitizer, 44" by 60" active area
Calcomp 1043 GT 8-pen plotter (E-size)
Tektronix 4696 ink-jet printer (A-size)
RELAX read/write optical disk drive with removable 600 MB cartridges
ISO-966 and High Sierra CD-ROMs
Exabyte 8mm tape backup
HP Scanjet Plus - 8 1/2" by 11"
HP Deskwriter - B7W Printer

Feature Projects/Research

Application of MapCam™
The purpose of the MapCam™ project is to design and build an all-digital image acquisition and photogrammetric processing system. Digital elevation models (DEMs) are automatically extracted and orthophotos are generated from the digital imagery.

Although MapCam™ will not replace conventional aerial mapping in the short run, a large number of applications have been identified. Applications include construction surveys, digital orthophotography and DEM generation. MapCam™ can also be an ideal source of data for photogrammetric softcopy stations.

Two flights were completed with the first generation MapCam™ system, yielding more than 200 images for post-processing. These images are currently being evaluated. An existing aerial triangulation program is being modified to accommodate the GPS observations in the airplane and provide control for point positioning. DEMs and orthophotos are generated using the ERDAS Digital Ortho Software Module which was developed by the Center for Mapping.

Work on the second generation MapCam™ has begun. The second generation MapCam™ will be easier to use and will feature moving image-display capability for navigation and flight planning. It will also use data compression and store images on digital tape, leading to storage capacity superior to the first prototype.

All images and GPS positions will be stored in a GIS combined with an image database to provide the user with complete digital mapping tools. It can also be interfaced with data collected by the GPSVan™, so that a combined analysis of aerial and van imagery is possible.

Generating Information from Scanning Ohio's Maps (GISOM) Program
For the past thirty years, cartographers have been producing maps more accurately and efficiently with the help of computer technology. These technologies have evolved to the point where mapped information is being employed by planners, engineers, scientists and developers.

Unfortunately the general lack of mapped information in computer readable form has limited the effective use of these technologies. In response to the need for digital data, the U.S. Geological Survey (USGS) has created a program to convert existing mapped data and information into computer-readable form. Through the Ohio State University Center for Mapping and the Ohio Geographically Referenced Information Program (OGRIP), Ohio is now participating in this USGS initiative.

The ultimate goal of the GISOM program is complete digital cartographic coverage for Ohio. This will give Ohioans the ability to use the power of computer systems to help protect the environment, improve transportation and

utility systems, coordinate urban revitalization or even enhance public services such as police and fire protection.

Existing mapped data covers units called quadrangles. Each quadrangle represents about a 60 square-mile area, and consists of several layers (or separates) of information including natural characteristics, transportation routes and cultural features. Researchers at the Center for Mapping use a high-resolution scanner (Optronics 5040) to process five data separates for each Ohio quadrangle. Once scanned, the data is enhanced through a series of editing procedures and converted into digital form.

Under the terms of the USGS cooperative agreement with the State of Ohio, an organization designates the quadrangle(s) in DLG-3 or Integraph format as well as associated hard copies. Optional services such as conversion to a different data format are also available for a fee.

Global Positioning System (GPS) Van Project

The Global Positioning System (GPS) Van Project began in September, 1989. It's purpose was to build a prototype vehicle to map highway transportation infrastructure features at normal traffic speeds with an accuracy of 1-3 meters. The project was funded by NASA, the Federal Highway Administration, 38 different State Highway Departments and the Alberta, Canada Transportation Department.

The van includes a satellite receiving station which determines the vehicle's geographic position by using the Global Positioning System (GPS) in differential mode. It also has a "dead reckoning" navigation system to keep track of its position when satellite signals are temporarily lost. An operator can add information by a PC keyboard, a touch screen, or an analog video system which uses a Super-VHS camera system. The Super-VHS camera system runs in continuous video mode at 30 frames per second, and captures a photo log of the survey. Each video frame is time tagged, and a geodetic coordinate is assigned to each image.

Additionally, a digital stereo camera system records stereo images of the roadway and adjacent features as the van moves down the highway. During post processing, coordinate positions of objects such as road edges and centerlines, curbs, street signs, mile markers, etc., are measured photogrammetrically with a precision of 5-10 centimeters within 10-40 meters of the van. Latitude and longitude positions can then be assigned to any selected object in view of both stereo cameras.

Data from the GPSVan™ can be converted into a format acceptable for entry into a Geographic Information System (GIS). After the information is analyzed, it can be used to monitor road and transportation features, and help set management priorities or develop databases of other information.

The prototype van is available for marketing demonstrations and actual surveys. Second generation vehicles are currently being built and sold for commercial purposes.

Funded Research

The Center for Mapping participates in several research projects which are funded by NASA as well as other corporate sponsors. Below is a list of some of the projects currently underway.

- Application of Magnetic Resonance Imagery for Modeling of Patellofemoral Joint Function
  Dr. Kurt Novak
  Geodetic Science and Surveying
- Automatic Raster-to-Vector Contour Conversion Interface
  Dr. J. Raul Ramirez
  Center for Mapping,
  Intergraph Corporation
- Automatic Registration of Digital Elevation Data with Remotely Sensed Image Data Using Geomorphic Models
  Dr. Kim L. Boyer
  Electrical Engineering,
  BWTechnology, Inc.

• A Decision Support System for Producing Resources and Oxygen on the Moon (PROM)
Dr. Fabian C. Hadipriono
Civil Engineering, Bechtel Corporation
• Development of a GIS Capability to Support "One Call" Utilities Protection Services
Dr. Grenville Barnes
Geodetic Science and Surveying, GeoVision Systems, Inc.
• Development of a Geoscientific Information System for Diamond Exploration in the North-Central United States
Dr. Douglas Pride, Geological Sciences
• The Development of a Production Model for the Generation of Digital Cartographic Data
Dr. J. Raul Ramirez, Center for Mapping, U.S. Geological Survey
• Development of a Road Matching Algorithm
Dr. Kurt Novak, Geodetic Science and Surveying
• The Development of a Scientific Information on Remote Sensing Techniques for Estimating Brant and other Wildlife Populations in Alaska
Dr. William H. Anderson, Center for Mapping, U.S. Fish and Wildlife Service
• Digital Elevation Models from Uncalibrated Image Pairs
Dr. Kim Boyer, Electrical Engineering
• Digitizing Ohio's Quadrangles
Dr. J. Raul Ramirez, Center for Mapping
• A Feasibility Study of Producing Elevation Maps from Stereo Images Using Algorithms Developed at The Ohio State University
Samuel S. Bair, Ohio Supercomputer Center
• Integrating Satellite, Airborne and Surface Geophysics for Global Hydrocarbon Exploration
Dr. Ralph R. B. Von Frese, Geological Sciences, Consortium of Hydrocarbon companies including Arco, Amoco, Carson Geoscience, Exxon, Texaco, Transworld Energy International and Unocal
• Landslide Hazard from Snowmelt
Dr. Tien H. Wu and Dr. Carolyn J. Merry, Civil Engineering, Timber-Fish-Wildlife Project, Washington Department of Natural Resources, Softdesk, Inc.
• Real-Time Satellite Mapping
Dr. Clyde C. Goad, Geodetic Science and Surveying, George J. Igel and Co., Inc.
•Surface Reconstruction from Aerial Imagery
Dr. Anton F. Schenk, Geodetic Science and Surveying, Intergraph Corporation
• Upgrading Boundary Information Obtained from Digitized Tax Maps for the Purpose of Creating a Digital Cadastral Overlay
Dr. Grenville Barnes, Dr. Burkhard Schaffrin, Geodetic Science and Surveying

Unique Personnel Expertise

In the ever-changing environment, expertise from many disciplines is needed to solve real world problems. That's why the Center for Mapping's varied and distinguished faculty is so important. Together, faculty, staff and graduate students develop knowledge from basic research and translate it into practical applications. Areas of expertise include:

• LIS, GIS applications
• Landscape Ecology and GIS
• Computer Vision, Image Understanding
• Remote Sensing
• Sampling, Probability
• Terrain Classification, Map Generalization
• Real-Time Digital Photogrammetry
• Modeling for Facility Siting
• Hydrologic Processes
• Soil Runoff and Erosion

National Aeronautics and Space Administration

Great Lakes Industrial Technology Center

Great Lakes Industrial Technology Center
25000 Corporate Center, Suite 260
Cleveland, OH 44070-5310
Dr. Joseph W. Ray
Executive Director
Phone: (216) 734-0094
FAX: (216) 734-0686

Lab Description

The Great Lakes Industrial Technology Center (GLITeC) is one of six NASA Regional Technology Transfer Centers (RTTCs) which form the National Technology Transfer Network (NTTN), established by NASA to make federal technology available to American industry. The purpose of the NTTN is to provide an effective, market-oriented means of deploying technologies from the federal R&D base to meet the technology needs of the U.S. private sector.

Unique Equipment, Facilities or Services

GLITeC draws on federal laboratories, universities, and state and Federal technology application centers to match client needs with appropriate technical solutions. To better serve the Great Lakes region, GLITeC also maintains a network of affiliates in each of the Great Lakes states to provide local relationships and insight into state programs and industry needs. GLITeC offers tailored technology consulting and commercialization assistance within three basic types of services: Technical Assistance, Technology Management, and Technology Commercialization.

Technical Assistance

Technical assistance services provide solutions to specific problems and usually involve matching a need with an appropriate technical solution. Services can range from identifying the appropriate technology or technical expert to assembling an interdisciplinary team to identify and evaluate alternative solutions.

Technology Management

Technology Management services are designed to help draw on technology as business opportunities. GLITeC can locate potentially relevant technology and technical expertise, produce associated feasibility and market studies, and assess alternative applications for existing technology. Individual projects are tailored to meet specific client requirements. GLITeC's Business and Technology Planning Services integrate the identification of technology requirements and opportunities, the evaluation of technology resources, and planning for diversifications or growth.

Technology Needs Analyses help define new technology needs or opportunities, and develop plans for acquiring and implementing technology to improve competitiveness and promote growth and diversification. Technology Evaluation Services start with a specific technology or technical concept and look for marketable applications or products, including the identification of alternative commercial applications and the assessment of technical feasibility and market potential for each application. Diversification Planning helps identify appropriate new product opportunities, locates relevant technology, and conducts associated product and market assessments.

Technology Commercialization

Technology Commercialization services are directed at acquisition and adaptation of technology for commercial applications. This includes licensing assistance, CRADA/SAA assistance, and SBIR assistance. GLITeC also provides technology development services aimed at adapting federal technology for commercial application. These include: applications projects to demonstrate the feasibility of a technology in a specific commercial application; targeted technology development projects to adapt technology for alternative applications; and product development assistance.

National Aeronautics and Space Administration

Lewis Research Center

Lab Description

The NASA Lewis Research Center defines and develops advanced technology for high priority needs. The work of the Center is directed toward new propulsion, space electric power, and communications technologies for application to aeronautics and space, so that U.S. leadership in these areas is ensured.

Lewis Research Center
National Aeronautics and Space Administration
21000 Brookpark Road
Cleveland, OH 44135
Mr. Anthony Ratajczak
Phone: (216) 433-3193
FAX: (216) 433-3344

Individual Laboratory Descriptions

Materials Division

This division focuses on materials for advanced aerospace propulsion systems, as well as microgravity materials science. Current emphasis in high temperature composite research covers intermetallic compounds, refractory metals, and new fibers for use in engine components for the space shuttle; advanced subsonic, supersonic, and hypersonic aircraft; and power systems for the Space Station. These research activities are supported by characterization laboratories which provide analysis of the chemical composition and microstructure of advanced materials.

Research areas include:
Advance Metallics
(216) 433-3230
Ceramics
(216) 433-3276
Polymers
(216) 443-3228
Surface Science
(216) 443-6061
Environmental Durability
(216) 433-5504
Analytical Science
(216) 433-5015
Processing Science and Technology
(216) 443-5013
Advanced Engine Materials
(216) 433-3195

Propulsion Systems Division

This division focuses on advanced propulsion systems primarily for aircraft, but also for ground transportation. The division has the capability to design entire engines, but concentrates on component development in support of the major engine manufacturers. Test facilities include automotive-type engine test stands, gearbox test rigs, engine component test stands, and full scale engine test stands that can accommodate large turbofan engines and simulate altitude cruise conditions. Aircraft icing buildup and prevention is studied in a unique icing wind tunnel. Several facilities are devoted to measuring noise propagated by various aircraft propulsion systems.

Research areas include:
Terrestrial Propulsion
(216) 433-3408
Combustion Technology
(216) 433-5970
Icing and Cryogenic Technology
(216) 433-3900
Mechanical Systems/Gear Design/Gearboxes
(216) 433-3915
Nozzle Technology
(216) 433-3933
Hypersonics
(216) 433-3949
Turbomachinery Technology
(216) 433-3944
Propeller and Acoustics Technology
(216) 433-3945
Inlets
(216) 433-2181

Space Electronics Division

The primary mission of this division is to develop technology for space communica-

tions. Much of its efforts are directed at advanced technology communications satellites. Microwave amplifiers, phased-array antennas, advanced integrated circuits, solid state circuits using high temperature superconductors, are some of the technologies being developed. The division has in-house fabrication capability, as well as test facilities for circuitry and antenna patterns.

Research areas include:
Image Data Compression
(216) 433-2847
Traveling Wave Tube Amplifiers, Microwave Power Modules, Vacuum Electronics
(216) 433-3515
Solid State Technology, Semiconductors, MMIC's
(216) 433-3500
Antenna and RF Systems
(216) 433-3471
Communications Signal Processing/Switching
(216) 433-3496
Superconductivity
(216) 433-3503

Instrumentation and Control Technology Division

This division develops advanced instrumentation and sensors for use in NASA research. The division maintains in-house fabrication capability and facilities for testing sensors.

Research areas include:
Research Sensor Technology
(216) 433-3725
Optical Measurement Systems
(216) 433-3728
Instrument Applications
(216) 433-3727
Engine Sensor Technology
(216) 433-3732
Advanced Controls
(216) 433-6328

Internal Fluid Mechanics Division

The primary mission of this division is to develop and verify computational fluid dynamics computer codes to be used to facilitate the design of future aerospace propulsions systems. Much of the effort is directed at the internal flow physics of ducts, nozzles and turbomachinery. CFD programs are being written for computer systems ranging from personal computers to mainframe systems such as the Cray XMP. Many of the resulting programs are available from COSMIC, and are in use by manufacturers of aerospace propulsion systems.

Research areas include:
Computational Fluid Dynamics
(216) 433-8133
Computational Technologies
(216) 433-3856
Heat Transfer
(216) 433-5883
Turbomachinery Flow Physics
(216) 433-5882
Aerothermochemistry/combustion/reaction kinetics
(216) 433-5850
Inlet, Duct, and Nozzle Flow
(216) 433-3607

Structures Division

The division addresses structures technologies applicable to advanced propulsion systems. Typically structural materials being studied and characterized have as desired qualities light weight and high strength, with high temperature durability. A major goal is the development of structural CAD codes for advanced materials. Much recent work has focused on ceramic materials, both monolithic and fiber reinforced ceramic matrix composites, as well as ceramic fibers.

Research areas include:
Composite Mechanics Models
(216) 433-3330
Composite Laminate Tailoring
(216) 433-3330
Structural Health Monitoring/ Impact Damage Tolerance
(216) 433-6738
Computational Mechanics
(216) 433-3260
Fatigue and Fracture/Test Methods and Standards
(216) 433-3340
Life Prediction for Brittle Materials and Structures - Fracture, Fatigue, and Creep
(216) 433-3210
Machinery Dynamics
(216) 433-3920
High Temperature Seals
(216) 433-6048
NDE for Refractory Materials and Structures -Radiography, Computed Tomography, Ultrasonics, Acoustic Microscopy
(216) 433-6019
Aeroelasticity, Flutter, Forced Response, Mistuning
(216) 433-3920

Power Technology Division

This division develops electrical power generation systems

and other electrical components for aerospace applications. This division performs all the NASA R&D efforts in photovoltaics, batteries, fuel cells, and solar dynamic systems. The division has in-house fabrication capability for prototype systems, plus component and system test facilities, some with the capability of simulating a space environment. Much recent work has focused on improving the durability of electrical systems in low-Earth-orbit.

Research areas include:
Photovoltaics
(216) 433-2303
Semiconductor Technology
(216) 433-2230
Photovoltaic Cell Fabrication
(216) 433-2227
Solar Cell Structures and Design
(216) 433-2228
Thin Film Solar Cells
(216) 433-3835
Concentrator Solar Cells
(216) 433-2231
Batteries
(216) 433-5248
Fuel Cells
(216) 433-6124
Motors and Electric Actuators
(216) 433-6152
Stirling Cycle Engine Technology
(216) 433-6140
Solar, Hybrid Vehicle and Refrigeration (Stirling Cycle)
(216) 433-6144
Space Environmental Effects
(216) 433-2307
Electrophysics/LEO Power Materials Durability
(216) 433-2308
Solar Dynamics Power Systems
(216) 433-5278
Solar Concentrators
(216) 433-6168

Unique Personnel Expertise

Over 5000 people staff Lewis, including civil service employees and support service contractors. Over half of them are scientists and engineers, who plan, conduct or oversee, and report on the research tasks and projects of the Center. They are assisted by technical specialists, skilled workers, and an administrative staff.

National Aeronautics and Space Administration

Space Automation and Robotics Center

Space Automation and Robotics Center
P.O. Box 134001
Ann Arbor, MI 48113-4001
Mr. David J. Conrad, Director
Phone: (313) 994-1200 ext. 2381 or 3350
Ms. Janice Nyman, Assistant Director
Phone: (313) 994-1200, ext. 2469
FAX: (313) 994-0944

Lab Description

The Space Automation and Robotics Center (SpARC) is a NASA Center for the Commercial Development of Space (CCDS). The mission of the CCDS program is to encourage U.S. private-sector leadership in space-related commerce. SpARC's mission is to facilitate the commercialization of space and space technologies through the application of automation. SpARC accomplishes this mission by stimulating the involvement and investment, by U.S. industry, in research, development, and commercialization activities that have near-term terrestrial significance and are extensible to market opportunities afforded by the space environment.

SpARC has three commercial objectives in support of its mission:

- Expansion of the earth observation/remote sensing industry
- Development of a spacecraft on-orbit servicing industry
- Development of a space automation supplier industry

Each of these objectives exploits a different attribute of the space environment, these being vantage point, infrastructure, and microgravity.

The key activities in the space industrialization effort involve developing the automation and robotics needed for space-based facilities and demonstrating the ability to transfer information and resources between separate systems. Through leading-edge automation and robotic technology, SpARC is helping to build the foundation for space industrialization.

Earth Observation Workstation

Advances in computer and electronic technology have reduced the cost of real-time direct broadcast of image data, which is used primarily for weather prediction purposes. SpARC's approach to commercializing this technology is to provide low-cost access to satellite remote sensing data through PC-based direct readout workstations and providing it to K-12 classrooms. Advances in direct readout technology also contribute to the development of SpARC's geographic information systems and remote sensing systems.

Autonomous Rendezvous and Docking

Commercial space facilities will need to dock periodically with space modules and platforms for repair, resupply, and transfer of harvested products and experiments. SpARC researchers are developing autonomous rendezvous and docking techniques to improve the operational efficiency of space assets – from multipurpose production and laboratory facilities to the Wake Shield Facility (WSF).

Robotic Substrate Servicing System (RS3)

SpARC's RS3 is a material handling system designed to increase the production capacity of the WSF, a free-flying satellite that is being developed by the Space Vacuum Epitaxy Center to manufacture new and improved thin-film electronic, superconducting, and magnetic materials. Increasing WSF capacity will extend the time between resupply/harvest missions, thereby reducing the manufacturing cost per wafer.

National Aeronautics and Space Administration

Wisconsin Center for Space Automation and Robotics

Wisconsin Center for Space Automation and Robotics National Aeronautics and Space Administration
University of Wisconsin -Madison
1500 Johnson Drive, #411 ERB
Madison, WI 53706-1687
Dr. Neil A. Duffie, Director
Phone: (608) 262-5524
FAX: (608) 262-9458

Lab Description

The Wisconsin Center for Space Automation and Robotics (WCSAR) is a Center for the Commercial Development of Space. Established in 1986, WCSAR is partially funded by NASA and industry sponsors, and is a joint effort of private industry, NASA, and the University of Wisconsin - Madison, one of the largest multidisciplinary research institutions in the world. The center is dedicated to developing technology for commercialization of automated systems for use in space and on earth. These systems will play a vital role in settling the new space frontier and achieving greater competitiveness in world markets.

Individual Lab Description

WCSAR activities center around an office situated in the heart of the University of Wisconsin - Madison campus. Outstanding university faculty and staff working with industrial consortium members are engaged in research efforts which will develop and expand space-related commercial opportunities. Research is conducted in many of the laboratory facilities found throughout the campus. The program is administered through the College of Engineering. A Management Advisory Board, comprised of representatives from industry, provides oversight and guidance to the WCSAR program. Cooperative activities with industry, associated universities, the State of Wisconsin, NASA HQ - Office of Commercial Programs, and the Johnson Space Center add to WCSAR capabilities and commercialization opportunities.

Researchers, scientists, and industry members are actively working in three major areas:

ASTROBOTICS™
Astrobotics is creating robotics and automation technologies capable of enhancing the ability of humans to live, travel and explore in space. Automation is especially useful for work in hazardous environments and those areas not easily accessible to humans. Multipurpose devices such as robots can serve as an extension of the astronaut, performing complicated and routine tasks outside the spacecraft or at remote locations in space.

ASTROCULTURE™
Astroculture is the development of automated plant growth facilities in space. These galactic gardens will enhance life in space by providing a plentiful source of oxygen and food, removing carbon dioxide, and purifying water for long duration and permanently manned space operations

ASTROFUEL™
Astrofuel is the mining and processing of helium-3, an extremely valuable source of safe, clean reliable fusion fuel. Recently discovered on the moon's surface, the amount of helium-3 on the moon is estimated to be the energy equivalent of ten times that of the earth's remaining fossil fuels. Successful transport of helium-3 back to earth may solve Earth's energy needs for centuries to come.

National Science Foundation

Center for Compound Semiconductor Microelectronics

Center for Compound Semiconductor Microelectronics
University of Illinois at Urbana-Champaign
127 Microelectronics Laboratory
208 North Wright Street
Urbana, IL 61801
Mr. Stephen G. Bishop, Director
Phone: (217) 333-3097
FAX: (217) 244-6375

Research Description

The research mission of the Center is a cross-disciplinary investigation of new concepts in optical and electronic materials, devices, and systems based on gallium arsenide and other III-V compound semiconductors. The core research of the National Science Foundation (NSF)-funded program is directed at solving the technological problems that underlie the implementation of high-performance optical interconnections and optoelectronic integrated circuits. These problems include multiple-layer epitaxial growth techniques, fabrication and characterization of semiconductor materials and structures, theoretical descriptions of the properties of the structures, and system studies of the optimum approach to the general problem of high-speed optical interconnections. The Center is housed in the $13.5 million Microelectronics Laboratory building - one of this country's premier III-V semiconductor research facilities. The building's 16 clean room labs and its 0.05 mm vibration isolation provide a superb environment for materials growth and device fabrication.

Unique Equipment, Facilities or Services

The Center is commited to providing the most advanced equipment available for shared use in CCSM-supported facilities. The core facilities have been financed by the special cooperation of CCSM, equipment manufacturers and industrial participants with the College of Engineering Coordinated Science Laboratory, Materials Research Laboratory, and Department of Electrical and Computer Engineering. Modern experimental facilities not only enable innovative research and up-to-date training for students, but also attract industrial participation and new faculty and student involvement. In addition to the four facilities described below, major computer resources are also available through campus facilities and the NSF-funded supercomputer centers, including the UIUC National Center for Supercomputing Applications.

Facilities for Artificially Structured Materials

One of the most promising approaches to the technological problems blocking the implementation of optical interconnections is through engineered, multiple-layered heterostructures, called artificially structured materials. Three crystal growth techniques, metalorganic chemical vapor deposition (MOCVD), molecular beam epitaxy (MBE), and chemical beam epitaxy (CBE), are used to prepare these structures. Several MOCVD and MBE reactor systems are presently available, including:

- EMCORE dual-chamber MOCVD system and computer-controlled growth process, monitoring, and safety features.
- Unique seven-chamber MBE facility, equipped with a variety of powerful characterization probes. (CCSM contributes a III-V growth chamber in this joint facility.)
- Perkin-Elmer 430 series MBE system, to be converted to a CBE system through the collaboration of EMCORE, Perkin-Elmer, and Center staff.

Facilities for Submicron Device Fabrication

The successful implementation of optical interconnects for digital systems requires the fabrication of structures with micron and submicron dimensions. The Center supports the following major equipment:

- Cambridge electron beam lithography system (EBMF 6.5)
- High-resolution, deep-UV optical lithography system
- Reactive ion etching system
- Oxide and nitride deposition systems
- Plasma-enhanced CVD system
- High-resolution scanning electron microscope

Facility for Ultra-high-speed Optical and Electrical Measurements

This facility measures the high-frequency performance of sources, detectors, and supporting electronics, the Center's equipment includes:

- Hewlett Packard 60 GHz network analyzer
- Cascade Microtech microwave probe system
- Analysis equipment from Tektronix
- Hewlett Packard 3Gbs/s error performance analyzer
- Hewlett Packard lightwave analyzer
- Ti:Sapphire laser

Facilities for Characterization of Ultra-high-purity Semiconductors

The Center supports equipment to identify and determine concentrations of residual impurities in high-purity materials grown by MBE and MOCVD techniques. The facilities use the following techniques:

- High vacuum scanning tunneling microscopy
- Variable-temperature Hall effect measurements and analysis
- Fourier transform photothermal ionization spectroscopy
- Low-temperature photoluminescence and magneto-photoluminescence
- Differential C-V analysis
- Electrochemical profiling
- Deep-level transient spectroscopy

Unique Personnel Expertise

Personnel are comprised of research engineers and professors with degrees in electrical and computer engineering, physics, and computer science.

CRADAs

The Center depends on the participation of engineers and scientists from industry. Substantive, long-term interaction with industry is essential in formulating research and development plans, in achieving the timely transfer of knowledge to industrial users, and in expanding and diversifying the financial base of the Center.

National Science Foundation

Center for Intelligent Manufacturing Systems

Center for Intelligent Manufacturing Systems
A.A. Potter Engineering Center
Purdue University
West Lafayette, IN 47907-1291
Ms. Nancy Bulger
Phone: (317) 494-7715
FAX: (317) 494-0811

Lab Description

This Engineering Research Center targets all technical activities in the manufacture of discrete products from early design to completion.

The Center focuses on the concept of Intelligent Manufacturing Systems (IMS) which go beyond current emphases on flexibility and computer integration to the next logical step in the evolution of manufacturing practices. In particular, an IMS will have the capability to respond promptly and correctly to changes in requirements. Such changes may be deliberate (as for a new product) or forced (for example, by machine breakdowns or material shortages). The key issue is responsiveness.

The Center does not endorse the concept of a fully automated factory (i.e., one without workers). Although selective automation can achieve greater speed with precise control, the replacement of direct labor can no longer be viewed as an end in itself. Thus, the goal is to achieve a total-system, including humans, that can function smoothly under highly dynamic and widely varying conditions.

To create a manufacturing system that has this property, here termed "intelligence", requires cross-disciplinary system integration. A wide variety of software is needed to assess rapidly the information aspects of alternative manufacturing choices. These tools must extend the scope of concerns beyond traditional boundaries. They must be able to function together as a coherent system. This cross-disciplinary integration is not likely to occur without deliberate, focused effort.

The Center's research program is organized in three related thrust areas:

- Product Design
- Materials Processing
- Factory Systems

The key technical issue in the product design thrust area is to anticipate the consequences of design choices on downstream activities. In the materials processing area, it is to achieve process predictability. Integration is the key technical issue in the factory systems area.

Projects in each thrust area produce enabling technology for the IMS and merge according to a planned schedule. Each project is organized as a team effort structured to meet specific needs of the IMS. Many of the incremental steps toward this goal also serve more immediate needs of industry. Specific projects target the following technical objectives:

- A high-level modeling system for design and subsequent analysis;
- Integrated analysis for functionality, manufacturability, cost, etc.;
- Process models that relate material composition and process parameters to final properties;
- Automated generative process planning and program generation;
- Knowledge handling methods, including distributed databases and diagnostics;
- Very responsive and flexible materials handling with sophisticated traffic control;
- A system for orderly communication;
- Sensing systems and related information processing;
- Basic theory and methodology for assembly;

• Tools and methods for design and control of large-scale factory systems.

Unique Equipment, Facilities or Services

The Center's laboratories and administrative offices occupy 16,000 square feet in two adjacent buildings centrally located among the University's complex of engineering buildings. Many Center projects make use of additional laboratories maintained by Aeronautical and Astronautical Engineering, Chemical Engineering, Industrial Engineering, Electrical Engineering, Materials Engineering, and Mechanical Engineering. The Center has a special room for cross-disciplinary interaction that is also used for meetings with its industrial collaborators. The Engineering Computer Network (ECN) links all local participants and provides the extension of communication to the industrial members. The ECN consists of a variety of interconnected mini and supermini computers - the equivalent of about 80 VAX 11/780 computers - and all of the supporting equipment and services. The Center also possesses a wide variety of special-purpose computers and manufacturing equipment to carry out its research.

National Science Foundation

Center for Interfacial Manufacturing

Lab Description

The mission of the CIE is to serve as a national resource that industry can draw on for the knowledge base to make decisions on the processing, fabrication, and performance of interfacial systems, and to educate a new generation of systems-oriented engineers with the cross-disciplinary skills to design and manufacture interfacial products.

Center for Interfacial Engineering
University of Minnesota
179 Shepherd Laboratories
100 Union Street S.E.
Minneapolis, MN 55455
Dr. D. Fennell Evans, Director
Dr. Elizabeth Starbuck,
Associate Director
Phone: (612) 626-2230
FAX: (612) 626-7530
E-mail: ostroot@staff.tc.umn.edu

To accomplish this mission, CIE:

- accelerates the development of interfacial engineering as a new interdisciplinary field via specific research programs and establishes a test bed for real-time analysis of interfacial processes
- provides new tools for design and manufacture of reproducible, reliable, and cost-effective interfacial products
- delivers to industry the necessary understanding of fundamental processes via short courses, faculty and industrial residencies, and workshops
- develops textbooks, courses, and practical experiences for students.

CIE conducts research in the following areas:

- Biomedical interfacial engineering
  - -synthesis and bioengineering of soft materials with improved pliancy, flexibility, and adaptability
  - characterization of biologically active surfaces
  - control of adhesion and growth at the device surface
  - control of adhesion and structural integrity in moist environments
  - development of effective fibrous structures
- Coating process fundamentals
  - optical imaging of coating and solidification
  - analysis of defect mechanisms
  - characterization of coating and solidification rheology
  - computational methods for analysis, design, control, and optimization of processes
  - development and application of tools for probing the microstructural evolution of solidifying coatings
- Polymer microstructures
  - controlled formation of microstructures containing complex interfacial topologies
  - dynamic properties that limit processing of block copolymers
  - control of phase morphology during processing of composites
  - stabilization of composite structure during use
  - optimization of adhesion and cohesion properties to prevent materials failure in composites
- Surfactancy and self-assembly
  - control of forces that determine structure and properties of molecular films
  - mechanisms that control film deposition and spreading, drying, and lubricating properties
  - molecular recognition principles in film deposition and growth and in sensor design
  - phase behavior and structure of association colloids
  - structure and chemical composition of molecular crystals
  - growth of crystalline solids
  - -relation between structure and performance of inorganic crystals and phase behavior of

solution precursors
- Thin film processing
  - control of chemical structure and physical properties of films
  - chemical mechanisms of film formation
  - predictive capabilities for chemical vapor deposition processing
  - control of stoichiometry of multicomponent films
  - control of microstructure in physical vapor deposition processing
  - mechanics of adhesion at interfaces
- Real-time imaging

National Science Foundation

Center for Net Shape Manufacturing

Engineering Research Center for Net Shape Manufacturing
The Ohio State University
1971 Neil Avenue
Columbus, OH 43210
Mr. Taylan Altan
Phone: (614) 292-9267
FAX: (614)292-7219

Lab Description

This Center focuses on the cost-effective manufacture of discrete parts. The scope of its research spans all stages of manufacturing from engineering materials to finish or near-finish dimensions by melt processing (casting, injection molding), shaping from powder, forming from sheet, and forming from billet. The Center's research is directed at reducing development time for new processes by eliminating trial and error through computer-aided techniques; predicting material flow as a component is shaped so that defects can be eliminated and product quality increased; narrowing dimensional tolerances; and increasing complexity of part shapes to make NSM more cost-effective.

In all these processes, geometry is the common thread and the technology of die/mold design and manufacturing is a significant consideration. In a net shape manufacturing process, a given material, usually shapeless or of simple geometry, is transformed into a useful part. The resulting part has a complex geometry with well defined shape, size, tolerances, appearances, and properties. The desired geometry is "stored" in the tools, dies, or molds and imparted to the material with or without pressure through the tool-material interface.

The goals of the Center are to:
- Reduce the development time for new processes by eliminating trial and error through process simulation and integration;
- Predict material flow and eliminate defects to improve product quality and consistency;
- Improve dimensional tolerances and increase achievable shape complexity to make net shape manufacturing more cost effective for wider use.

Center research is guided by the belief that in the future, design and manufacturing will be truly integrated. Based on functional requirements, the geometry (shape, size, surface finish, and tolerances) and the material (composition and heat treatment) of a part are selected at the design stage. Decisions made at this stage also determine the overall manufacturing, maintenance, and support costs associated with the given product. Consequently, the designer uses the part geometry as the common link and starts with an alternative design using appropriate software for structural, heat transfer, and fluid flow analysis. The designer then explores several design and manufacturing alternatives before selecting one of the design alternatives.

The key research issues of this approach are:
- Design for producibility by net shape manufacturing and preliminary design of dies and molds. These are non-algorithmic activities and can benefit from the Expert Systems methodology by storing the design experience in a systematic manner.
- Computer modeling of net shape manufacturing processes. Development of such models requires determining behavior of the materials under processing conditions, understanding the phenomena at the tool-material interface, including friction and heat transfer, and the mathematical modeling of the

mechanism of shape and property change.
• Development of novel concepts for tooling, machines, and material handling. These involve tool and die design and manufacture, machinery, handling devices, and automation, and plant layout and management.

Several demonstrations or validations have been undertaken to consider systemically the above issues and to guide the overall research direction of the Center. This is done in close cooperation with the industrial members of the Center in each major research area: die casting, polymer processing, sheet forming, billet forming, and die/mold manufacturing.

Organizational Structure

To conduct research and education in the field, the U.S. National Science Foundation (NSF) established the Engineering Research Center for Net Shape Manufacturing at Ohio State in 1986. It is one of nineteen engineering research centers funded by the NSF, and the only one involved in net-shape manufacturing.

Unique Equipment, Facilities or Services

Computer Facilities

• Cray YM-P supercomputer
• IBM RISC 6000 workstations
• Vax, Apollo, and Sun workstations

Computer Programs for Process Simulations

Billet Forming

• DEFORM (FEM based code for 2-D non-isothermal simulation of metal flow in plastic deformation processes such as forging and extrusion/on VAX/VMS)
• AMG (Automatic Mesh Generation for DEFORM/on VAX/VMS)
• RNGROL (code based on slab method for non-isothermal simulation of the ring rolling process/on Vax/VMS)
• TASK (Hybrid, FEM and slab method based, 2 and 1/2D code for simulation of isothermal metal flow in shape rolling/on VAX/VMS)
• RING (FEM based code for simulation of 3-D metal flow in rolling of profiled rings/on 3-D FLOW (for fluid flow analysis for CRAY YMP8/864 Supercomputer))
• ERCBLG (For predicting the roll separation force and spread in flat rolling of bars/on VAX/VMS)
• RFORGE (For estimating forces, temperatures, and metal flow in radial forging of tubular products)
• DIELOAD (To estimate forging pressures and load in closed die forging with flash)

Sheet Forming

• SHEET-FORM (an Expert System and Finite Difference based program to establish forming sequences and to simulate deformation in deep drawing, redrawing and reverse drawing of round sheet metal parts)
• SECTION-FORM (FEM based program to simulate deformation in plane strain deep drawing and stretch forming operations, used for analyzing sections of complex sheet metal stampings)

Die Casting

• DIE CAST-DESIGN (Intelligent CAD System for die-cast part design)
• DIE CAST-2D (A 2-D FEM program to simulate flow and solidification in thin castings)
• MAGMASOFT (A 3-D FDM program to simulate flow and solidification in casting)
• O-SOLID (an FEM program to simulate 2-D solidification in permanent mold or sand casting and die casting)
• WAVEFORM (a program to predict the shape of the wave in shot sleeve of a die casting machine)
• FLOW-3D (A 3-D code for solving time dependent equations for fluid flow with or without free surfaces, used for simulation or die cavity filling, hosted on OSU's Supercomputer)

Polymer Processing

• RTM (for simulation of isothermal or non-isothermal mold filling and cutting in liquid composite molding)
• SMC (for simulation of non-isothermal mold filling and curing in compression molding of Sheet Molding Compounds)
• MF-FLOW/MF-PACK/MF-COOL/MF-WAR/MF-STRESS (FEM and FDM based modules of the MOLDFLOW injection molding software to simulate cavity fill, packing,

heat transfer, shrinkage and warpage, and structural analysis)
• C-DESIGN/C-VIEW/C-TRANS/C-SET/C-GASFLOW/C-FLOW/C-PACK/W/C-COOL (Modules of the C-FLOW injection molding software to simulate the process and investigate process parameters

Design and Manufacturing
• TOOLCHEST (Surface Modeling and NC machining package/on IBM RISC 6000)
• CATLA (surface and solid modeling and NC package/on IBM/VM)
• CADAM (surface modeling, drafting, and NC package/on IBM/VM)
• PRO/ENGINEER (Solid Modeling Design software on IBM RISC 6000)
• PATRAN
• I-DEAS (IBM/VM, VAX/VM)
• NEXPERT (Expert System Shell/on IBM RISC 6000)
• VALISYS (CATLA-CMM data transfer interface)
• ABAQUS

Processing Equipment for Experimental Studies
• Triple Action Servo Motor Controlled 5 ton Press for Physical Modeling Studies in forging, extrusion and sheet metal forming (designed and built at the ERC/NSM)
• Double Acting 160 ton Minster (Tranemo) Hydraulic Press with computer control for sheet metal forming and cold forging (March 199)
• Sheffield Coordinate Measuring Machine to measure manufactured dies and parts
• Buhler 250 metric ton cold chamber die casting machine for die casting experiments
• Harvill 350 ton cold chamber die casting machine
• Rimrock robotics accessories for deeding the shot sleeve and lubricating the dies in die casting and for part extraction
• Prince transparent shot sleeve test stand with VISI-TRAK control for conducting model experiments in die casting
• Krauss-Maffei Reaction Injection Molding (RIM) Machine and associated dies for polymer processing research
• Fully instrumented 83 ton electric drive FANUC/Cincinnati Milacron injection molding machine
• Okada Model Maker/Vigitizer for 3 axis CNC machining of dies and models
• Showa Seiki Die Polishing Robot for automatic finishing and polishing of dies and molds
• AGIE Plunge EDM Machine for die and part manufacturing
• SODICK Wire EDM machine for die manufacturing
• Cincinnati Milacron T-10 3 axis CNC Machining Center
• Bridgeport Series 1 CNC 3 axis vertical milling machine
• Federal Products Profilometer Model Surfanalyzer 4000
• Various metal cutting machining tools

Unique Personnel Expertise
Over the past 7 years, the number of people involved with the ERC/NSM has increased significantly. This includes faculty and students from five departments within the College of Engineering, including Mechanical, Electrical, Chemical, Material Science and Engineering, and Industrial and Systems Engineering.

Technology Transfer Activities
To date, the ERC/NSM has issued about 350 technical reports. More than 5,500 reports have been requested and distributed to member companies. In addition, 152 copies of various software packages developed at the ERC/NSM have been licensed to various companies.

The ERC/NSM has more than 70 company members which provide the Center with nearly 1/3 of its total operating budget through membership fees. (Some 30+ member companies are small businesses, having less than 500 employees).

The ERC/NSM continues to expand its working relationships with various universities (Cleveland State, Wisconsin, Colorado School for Mines, Florida, U.C. Berkeley), community colleges (Columbus State, Central Ohio Technical), professional associations and centers (IAMS, CAMP, NADCA, FIA,

(IAMS, CAMP, NADCA, FIA, ASM, SME), federal agencies (Air Force, Army, NASA) and the State of Ohio (Steel Futures and Edison Programs).

On an international level, they have established excellent ties with several German universities, specifically with Aachen (WZL-Machine Tool Laboratory, Fraunhofer IPT-Institute for Production Research, IKV-Institute for Polymer Processing, IBF-Institute for Metal Forming), Hanover (Institute for Production, Institute for Forming Technology), Stuttgart (Institute for Forming Technology), and Esslingen (Institute for Polymer Processing and Production Technology).

National Science Foundation

Center for Plasma-Aided Manufacturing

Center for Plasma-Aided Manufacturing
University of Wisconsin-Madison
1410 Johnson Drive, Room 101
Madison, WI 53706-1608
Prof. J. Leon Shohet
Phone: (608) 262-2181
FAX: (608) 262-3632

Lab Description

The technical goals of this Center are to:

- Explore new plasma processes which produce advanced materials and products of importance to manufacturing
- Generate fundamental control strategies which can be utilized for manufacturing.

Center research addresses two types of plasma processing that are relevant to manufacturing industries:

- Nonequilibrium or glow discharge plasma processing is used in sputtering, etching, polymerization, and surface modification;
- Thermal plasma processing is used for melting and smelting metals, spraying metals and ceramics, synthesis of powders, and chemical production.

Center research projects are organized under four thrust areas and are phenomenologically interrelated:

- Plasma etching and microwave processing for microelectronics;
- Plasma deposition and polymerization;
- Plasma synthesis, sintering and spraying of high-technology ceramics, and refractory materials;
- Plasma modification of materials.

Research involving thermal plasma is carried out jointly with the University of Minnesota.

Unique Equipment, Facilities or Services

Central facilities include offices and a large laboratory that contains a number of different plasma-etching and deposition reactors. The Diagnostics Statistics and Technical Support Groups as well as the computing center for Theory and Modeling occupy spaces that adjoin the laboratory. Research on plasma modification of materials takes place in a laboratory that is specifically designed for the special requirements of the processing system. Plasma spraying, sintering, and synthesis experiments are performed in well-equipped laboratories at the University of Minnesota.

Utilities include a high-capacity hazardous gas and vacuum pump exhaust system, gas and fume hoods, a central recirculating process cooling loop, and a dry nitrogen distribution system.
The Center presents seminars, short courses, and videotapes for University of Wisconsin and University of Minnesota students and for all persons interested in the rapidly advancing plasma technology. Center faculty members participate in the University's Research Apprenticeship Program,

through which minority and other high school students participated in the Center for eight weeks during the summer to learn about and take part in research on plasma-aided manufacturing. A variety of other educational activities are ongoing, including:

- New graduate and undergraduate courses in plasma-aided manufacturing;
- An ERC/Society of Women Engineers (SWE) undergraduate internship program;
- A summer program for precollege students and their middle or high school instructors to spend two to four weeks conducting hands-on research projects;
- A program with the Madison Area Technical College to involve their technical faculty and students in Center Activities;
- A program for faculty and students from minority universities to spend the summer conducting research at the Center.

The Wisconsin Plasma Processing and Technology Research Consortium (WISPP) with 26 participating companies is the vehicle through which industry interacts with the Center. Participating companies accept Co-op and summer intern students, provide research opportunities for staff and graduate students at their sites, and undertake joint Center/industry projects. Industrial researchers also spend sabbaticals in campus laboratories and classrooms.

Unique Personnel Expertise

Research at the Center brings together cross-disciplinary teams of engineers, scientists, and others expert in plasmas, chemistry, materials, statistics, microelectronics, manufacturing, physics, and a variety of engineering disciplines. It also involves such other centers at the University of Wisconsin-Madison as the Center for Quality and Productivity Improvement, the Manufacturing Systems Engineering Program, the Center for Applied Microelectronics, and the Sematech Center of Excellence in X-ray Lithography.

Technology Transfer Intermediaries

Illinois

Governor's Science Advisory Committee
Stratton Office Building
Room 107
Springfield, IL 62706
Ms. Karen A. Witter
Executive Director
Phone: (217) 524-1172
FAX: (217) 782-6620

The Governor's Science Advisory Committee (GSAC) was formed in 1989 with the goal of leveraging Illinois' scientific and technological strengths for the benefit of the Illinois economy. Dr. Leon Lederman, Nobel laureate in Physics and former director of Fermi National Accelerator Laboratory, has served as Science Advisor to the Governor and Chairman of the Governor's Science Advisory Committee since its creation. Included on GSAC are university research directors, corporate technology directors, the leaders of the State Scientific Surveys, directors of the national laboratories in Illinois, and other top university scientists and engineers.

The Illinois Coalition was also formed in 1989 as an independent not-for-profit organization to work with GSAC to strengthen Illinois' economy through science and technology. The Board of Directors of the Illinois Coalition includes CEO's of Illinois' major businesses, top labor leader, presidents of research universities, leadership of the Illinois General Assembly, and the Governor's Chief of Staff.

A major role of the organizations is to administer a vigorous review process to recommend to the Illinois Department of Commerce and Community Affairs and the Governor projects to be funded through the Technology Challenge Grant Program. This grant program was created to leverage private and federal research and development projects and to identify and develop technology programs capable of commercialization. To date the grant program has leveraged over $180 million in federal and private sector funding for science and technology projects.

The responsibilities of the Governor's Science Advisory Committee were expanded in 1991 to include additional emphasis on the role of science and technology in addressing environmental issues, and appointed a number of environmental experts to the Committee.

Responsibilities of the Governor's Science Advisory Committee include:

- advising the Governor on state policies impacting science and technology and their affect on productivity and competitiveness
- recommending projects to be funded by the Technology Challenge Grant Program
- documenting environmental trends and issuing a biennial report on the state of the Illinois environment (Critical Trends Assessment Project)
- increasing awareness of contemporary and emerging environmental issues that pose implications for public safety and advising the Governor on state policies impacting natural resources and the environment
- working to make the state a center of innovation in the development and application of environmental protection technology
- helping to improve the math, science, and environmental literacy of students and citizens throughout the state.

Technology Transfer Intermediaries

Indiana

Business Modernization and Technology's mission is to serve the state's small and medium-sized companies throught this decade and beyond. The goals are business expansion, job creation-retention, and small business growth.

Indiana Business Modernization and Technology Corporation
One North Capitol Ave., Suite 925
Indianapolis, IN
46204-2242
Phone: (317) 635-3058
FAX: (317) 231-7095

The corporation pursues its business modernization goals through direct proactive programs which it has created, and by coordinating local, statewide, and regional delivery of many of the state's existing business development resources. BMT's mission is also served through allied programs for which the corporation has been assigned budgetary and coordinating responsibility. BMT provides the following services:

- Manufacturing Technology Services

The MTS program is a BMT initiative which provides no-fee, full-service manufacturing and business support to Indiana companies. The program is implemented by MTS directors operating in each of Indiana's 14 statewide economic development regions.

- Indiana Microelectronics Center

The IMC, a division of BMT, is a custom microchip consulting service and low-cost design facility. Based in Fort Wayne, Indiana, the IMC operates statewide to help Indiana electronics companies keep their products on the competitive edge.

- Seed Capital Fund

This BMT funding program provides support for new product and process development. This fund has catalyzed the start-up of numerous entrepreneurial companies and new products.

- Commercialization Fund

This BMT fund is a resource for moving products and processes into the mainstream of the marketplace. The fund helps the state's small and medium-sized companies get their products commercialized at an earlier stage.

- SBIR Bridge Fund

This BMT fund leverages federal dollars for small business innovation research. The fund enables Indiana companies which are participating in the SBIR procurement program of the federal government to access contract grants from numerous government agencies participating in the program.

- Centers of Technology Developement and Service

These BMT-funded programs facilitate the transfer of new technology to industry. Through active industrial partnerships, the resources of the state's universities are strengthening the Indiana economy.

- Technical Assistance Program

The TAP utilizes BMT support and Purdue University technical and engineering expertise to solve problems for Indiana companies. More than 1,600 companies have used this program to improve manufacturing operations, define problems, learn technical alternatives, and obtain guidance.

- Technical Information Service

TIS utilizes BMT support and Purdue University resources to conduct information searches for Indiana companies and track technology advancements and industry trends. Frequent inquiries involve marketing, engineering technology, and management. Manufacturers, service industries, entrepreneurs, and others find this service quick and efficient.

- Industrial Research Liaison Program

The IRLP utilizes BMT support and Indiana University resources to deliver business assistance and technology transfer services to Indiana companies, government units, and social agencies. Services include access to business and technical databases, and grant writing assistance.

- Great Lakes Industrial Technology Center

GLITeC is a NASA-funded technology transfer program which has teamed up with BMT to unlock the doors to federally developed technology for access by Indiana companies. Through this program, BMT can help Hoosier firms find the technology they need to strengthen their market positions.

Technology Transfer Intermediaries

Michigan

The National Center for Manufacturing Sciences is a not-for-profit collaborative research, development and technology transfer corporation organized under the National Cooperative Research Act of 1984 and incorporated under the laws of the state of Delaware.

The Center's membership is comprised of U.S. and Canadian corporations and non-profit organizations committed to making their nation's manufacturing industries globally competitive through the development and implementation of next-generation technologies and management practices.

Member companies and NCMS staff direct projects within a strategic framework, with NCMS locating the best organizations to carry out and coordinate the research efforts. NCMS then plays an important role in technology transfer by further promoting the implementation of research findings among member companies, and their suppliers and customers.

National Center for Manufacturing Sciences
3025 Boardwalk
Ann Arbor, MI 48108-3266
Phone: (313) 995-0300
FAX: (313) 995-4004

The NCMS Manufacturing Information Resource Center can provide rapid, accurate solutions to broad-ranging information and research problems. Members have access to the NCMS-TRACK database, the NCMS collection of information and materials, and through their information specialists, hundreds of external databases – many sources of information that can answer manufacturing related questions ranging from legal and competitive issues to those highly technical in scope. Electronic mail and bulletin board capabilities enable almost immediate responses to queries as well as ready information exchange to NCMS staff and between members themselves. NCMS is committed to providing the resources necessary to ensure members have all the information that is required to make the kind of business decisions that will give them an edge in the global marketplace.

NCMS provides services in the following areas:

- Research services
- Document delivery/collection development
- Databases and bulletin boards
- Library services
- NCMS publications and translations
- Information systems

Technology Transfer Intermediaries

Michigan

The funding support provided by the National Institute of Standards and Technology (NIST) and the Michigan Strategic Fund (MSF) allows the MMTC to provide services to small and medium-sized manufacturers with significant cost savings. By serving these manufacturers in more than 600 projects, the Industrial Technology Institute (ITI) has developed capabilities to effectively apply manufacturing technologies in affordable ways. The MMTC is headquartered at ITI with regional centers located throughout Michigan. The Center also draws on experts from an extended network of resources, which include community colleges, universities, and economic development organizations.

MMTC can introduce these companies to innovative technologies and methods that have been tested and proven effective. Their recommendations are objective and not profit based because their primary goal is to transfer technology and skills to these small and medium-sized manufacturers, so they may compete more successfully.

NIST/Midwest Manufacturing Technology Center
Industrial Technology Institute
P.O. Box 1485
Ann Arbor, MI 48106
Phone: (313) 769-4000
FAX: (313) 769-4064

MMTC Services

- Assessment and Implementation Planning

The MMTC provides an independent evaluation of the total manufacturing system or in-depth analysis of areas of special concern.

- Select, Apply and Manage New Technologies

MMTC assistance reduces the risks inherent in key technology investments, including: CAD/CAM, CAE, CNC, sensors and controls, local area networks (LANs), and new process equipment and technologies. The MMTC is qualified to help identify, select and provide engineering assistance in implementing the technologies that can increase competition.

- Implement Quality, Delivery, and Cost Reduction Projects

The MMTC can help implement successful projects for improving quality, cost and delivery. With capabilities ranging from set-up reductions and visual management systems through Total Quality Management and continuous improvement systems, the MMTC can help identify and implement projects which fit company needs.

- Information Exchange

The MMTC coordinates and supports information exchange with groups of manufacturers and major customers to find solutions to critical problems. The Continuous Improvement Users Group for manufacturers are focused on real-world implementation. These groups have helped participating companies improve material and work flow, use new approaches to real-time problem solving, achieve reduced setup time, adopt cellular manufacturing techniques for small lot production, improve parts quality, and provide ongoing opportunities to learn from other manufacturers. Specialized seminars from the MMTC address areas critical to manufacturing companies.

Technology Transfer Intermediaries

Minnesota

Minnesota Project Innovation (MPI) is a private, non-profit organization that assists the successful formation and growth of Minnesota small business through:

- Maximizing the receipt of federal funds by high technology companies through the Small Business Innovation Research program.
- Providing business development assistance to high technology companies, with the primary emphasis toward the SBIR award winners.
- Identifying and facilitating the transfer of technologies developed in federal laboratories to state businesses for commercialization and/or increased competitiveness.
- Assisting small, small disadvantaged and women-owned businesses in successfully bidding on federal contracts as prime and/or subcontractors.

Minnesota Project Innovation, Inc.
111 3rd Avenue South
Suite 100
Minneapolis, MN 55401-2551
Phone: (612) 338-3280

To help Minnesota businesses access federal funding and technology transfer opportunities, a series of free or low-cost workshops are offered on general SBIR info, proposal preparation, market evaluation, federal research info, technology transfer and procurement basics, etc. MPI has developed SBIR-SEARCH for Minnesota companies, which is a database that indexes thousands of technology solicitation topics available at participating SBIR agencies. MPI also offers two electronic services for procurement clients. The first service offers electronic monitoring of the Commerce Business Daily and other accessible bidder bulletin boards. These buying activities are scanned for matches with MPI client profiles and provided daily by fac or mail. The second service offered covers the procurement history from the Federal Supply Catalog and related databases. MPI also is a public access site for Minnesota Project Outreach, an information database system that helps Minnesota entrepreneurs and small businesses access technical experts and business assistance resources.

MPI is a specialized Small Business Development Center (SBDC) and the Minnesota affiliate for the Great Lakes Industrial Technology Center (GLITeC).

Technology Transfer Intermediaries

Minnesota

Minnesota Technology Inc. is a nonprofit corporation established to assist Minnesota manufacturing companies in becoming more competitive. It's part of the state's strategy to strengthen its economy and preserve and increase jobs in Minnesota.

Minnesota Technology Inc./NIST-Upper Midwest Manufacturing Technology Center (UMMTC)
111 Third Ave. South, Suite 400
Minneapolis, MN 55401
Phone: (Metro) (612) 338-7722
(Statewide) (800) 325-3073
FAX: (612) 339-5214

In a cooperative agreement with the U.S. Department of Commerce's National Institute of Standards and Technology (NIST), Minnesota Technology established the Upper Midwest Manufacturing Technology Center (UMMTC), which operates as a division of Minnesota Technology.

Through the UMMTC, Minnesota Technology works with small/medium sized manufacturing companies to identify competitive barriers, secure expertise and objectively manage projects that streamline processes, improve product quality and reduce manufacturing costs, rework, inventory and waste. The corporation makes some limited equity investments to stimulate new products and the growth of new, start-up, technology-based companies.

Minnesota Technology and the UMMTC also assist manufacturing companies – both one-on-one and through consortiums – in finding technology and technology information that's available through national labs, universities, the Department of Energy and large private company labs. The organizations also help in creating partnerships between industry and technology sources to do cooperative research or to develop licensing agreements for such technology, especially in the areas of fabricated metals, computers and electronics, plastics and composites and scientific and medical instruments.

Specialty Areas

- Information
- Product, process improvements
- User groups, networks
- Demonstrations, workshops
- Supplier/OEM specifications
- Modernization, strategic planning
- Regional technology forums
- Workforce development

Regional Offices

The corporation works with companies statewide, and has offices in the following cities:

Moorhead (218) 236-8584
Rochester (507) 285-7184
Twin Cities (612) 338-7722
Redwood Falls (507) 637-2010
St. Cloud (612) 654-5201
Virginia (218) 741-4241

Technology Transfer Intermediaries

Ohio

Cleveland Advanced Manufacturing Program
4600 Prospect Avenue
Cleveland, OH 44103-4314
Mr. Stephen J. Gage
President
Phone: (216) 432-5300
Fax: (216) 361-2900

All aspects of manufacturing-related advanced technology research and technology transfer, development and application, plus employee skills upgrading. CAMP's principal areas of activity include general engineering, CAD/CAM/CAE/CIM, tribology and wear testing, computer simulation of processes, automation machinery, environmental engineering, chemical and biochemical sensors, microfabrication, micromachining and microactivator technology, robotics, expert systems and other artificial intelligence applications and customized education and training programs for the workplace. CAMP's academically based facilities include an 11,000 square-foot demonstration, education and training lab featuring a fully automated robotic CIM cell.

Services

CAMP conducts one-on-one improvement projects, basic and applied research, literature searches, training and seminars to a wide range of industries. Services include

- productivity improvement projects
- factory assessments
- microelectronic prototype fabrication facilities
- a technology hotline and newsletter
- a manufacturing resource database
- industry networking, environmental problem solving
- orums and workplace training.

Technology Transfer Intermediaries

Ohio

The Edison BioTechnology Center (EBTC) promotes the growth of the Ohio biomedical/biotechnology industry by assisting biotech companies, funding research and development projects, providing timely information through programs and conferences, and building collaborations between industry and research institutions.

In addition, staff at the Ohio University Edison Biotechnology Institute (OUEBI), an EBTC center of excellence, provide expertise in many areas of molecular, cellular and developmental biology. Major areas of emphasis are:

- gene delivery systems
- gene expression analysis systems
- human gene therapy systems
- embryology and cell/tissue culture science
- animal models for disease and pharmaceutical evaluation
- improved agricultural species

Edison BioTechnology Center
1100 Cedar Avenue
Cleveland, OH 44106
Dr. Cinda Herndon-King
Vice President, Technology/Education
Phone: (216) 229-0400
Fax: (216) 229-7323

Services

Business Development
EBTC uses its extensive resource network as well as its staff expertise in FDA regulation, marketing and management, and intellectual and property protection to help companies/entrepreneurs address specific business issues.

Seminar Programs
EBTC offers an annual series of conferences that cover a variety of biotechnology-related topics, from licensing strategies to regulatory problems to ethical issues. EBTC also hosts BioTech Ohio, a bi-annual statewide conference.

Project Funding Activities
EBTC funds research with commercial potential at institutions and facilitates access to other state and non-state funding programs for companies. EBTC also assists institutions in commercializing promising technologies.

Industry Survey
EBTC tracks Ohio's growing biomedical/biotechnology industry through its annual company directory.

Ohio University Edison Biotechnology Institute
OUEBI offers a broad range of services including: production of transgenic animals, gene expression analysis, preparation of gene constructs, gene sequence analysis.

Technology Transfer Intermediaries

Ohio

The Edison Industrial Systems Center's (EISC) goal is to boost manufacturing competitiveness by putting technology to work on the factory floor.

Edison Industrial Systems Center
1700 North Westwood Avenue
Suite 2286
Toledo, OH 43607-1207
Dr. Lionel J. D. Sully
Vice President, Technology
Phone: (419) 531-8610
Fax: (419) 531-8465

Technology/Services

Technology Deployment

EISC is moving companies toward world class excellence through continuous improvement and manufacturing modernization in the areas of:

- quality improvement (machine vision, industrial computed tomography, TQM, ISO9000)
- advanced coating technologies
- food manufacturing technology
- CAD/CAM/CIM/CAE
- technical information data access
- benchmarking assessments (competitiveness, environmental)
- plant layout/workcell design

Technology Development

EISC is applying new technologies, via consortial or proprietary projects, to current manufacturing processes to enhance quality and productivity, reduce cost, minimize waste and protect the environment. Notable examples include, but are not limited to: rapid prototyping, photochemical science, laminated mold design, CAD and image processing software design, and materials development.

Training and Education

EISC is providing the avenues for industry to attain global competitiveness by building and maintaining a highly skilled and rewarded workforce through: technical forums, workshops, worker retraining, school-to-work transition, custom technical training, and curriculum development.

Business Assistance

Helping to assure the development and success of entrepreneurial and small, growing companies by linking them to critical resources, EISC's Northwest Ohio Business Assistance Program is the gateway to programs such as: Small Business Innovation Research (SBIR) technical assistance, federal laboratory technology transfer, venture capital opportunities, commercialization and business planning.

Technology Transfer Intermediaries

Ohio

Edison Materials Technology Center
3171 Research Drive
Kettering, OH 45420-4006
Dr. Dan Markley
Executive Director
Phone: (513) 259-1365
Fax: (513) 259-1303

The Edison Materials Technology Center's (EMTEC) goal is to help industry become more competitive through the application of materials and materials processing technology. Materials and Processing (M&P) technologies include materials such as metals, ceramics, composites and polymers and the unit processes which convert these materials into marketable products, such as casting, forging, heat treating, machining, coating and finishing.

Services

All services are specifically structured to help maintain or increase a member organization's competitiveness in the work market. This is accomplished through a combination of problem solving activities designed to remove obstacles to competitiveness and the introduction of new, low to medium risk technologies to provide an edge in the marketplace. Emphasis is on advanced development, transfer and commercialization of M&P technology by Ohio industry.

Technology Transfer Intermediaries

Ohio

The Edison Polymer Innovation Corporation (EPIC) provides technical resources to help polymer related companies grow and prosper. EPIC technology includes applied polymer research and development of new materials, processes and supporting technologies. Focus areas include polymer composites, coatings, adhesives and sealants, polymer blends and alloys, polymer processing and rubber and elastomers.

Services

- Analytical and testing services for processors, molders and fabricators of polymeric products through the EPIC Applied Research Laboratory.

Edison Polymer Innovation Corporation
10235 Brecksville Road
Brecksville, OH 44141
Mr. Charles T. Rivenburgh
Director, Technology Transfer
Phone: (216) 838-5015
Toll-Free: (216) 1-800-257-EPIC
Fax: (216) 838-1567

- Scale up to kilogram quantities of polymeric materials at the EPIC Mini Pilot Polymerization Plant.
- Evaluation of physical and reactive polymer blends at the EPIC/M.A. Hanna Blending and Compounding Center.
- Liaison, consultancy and technical services.

Technology Transfer Intermediaries

Ohio

The Edison Welding Institute's (EWI) goal is to enhance the competitiveness of companies through improved materials joining technology. EWI's technology includes all aspects of materials joining, including welding processes (arc, laser, solid state, resistance, brazing, microjoining), engineering (mechanical performance, design, fatigue, fracture, fitness-for-service, numerical analysis and finite element modeling), materials (ferrous, nonferrous, advanced materials, plastics, composites, ceramics), quality control, automation, sensors and controls.

Edison Welding Institute
1100 Kinnear Rd.
Columbus, OH 43212
Dr. John C. Lippold
Manager, Research
Phone: (614) 486-9400
Fax: (614) 486-9528

Services

EWI addresses and resolves materials joining and engineering issues for member companies. This is accomplished through consultancy, proprietary project work, basic and applied research, training materials, seminars and programs, and extensive database accessed literature searches. EWI works with all industries including: automotive, aerospace, appliance, electronics, heavy manufacturing, medical, petrochemical, plastics, primary metals, utilities and welding equipment and consumable manufacturers.

Technology Transfer Intermediaries

Ohio

The Institute of Advanced Manufacturing Sciences' (IAMS) major purpose is to help manufacturing companies become more competitive and more profitable through applied technology. The Institute provides manufacturers with access to information, technologies and personnel needed to solve manufacturing related problems. The scope of IAMs includes machining and machine process improvement, material handling, pollution prevention and computerized manufacturing applications.

Institute of Advanced Manufacturing Sciences
1111 Edison Dr.
Cincinnati, OH 45216-2265
Dr. John B. Woodard
President
Phone: (513) 948-2000
Fax: (513) 948-2109

Services

A wide range of services are available at IAMS including research and development, technical publications, manufacturing "help lines," current awareness events, industry membership programs, training and education programs, workshop forums, as well as technical assistance in the form of implementation projects.

Technology Transfer Intermediaries

Ohio

Great Lakes Industrial Technology Center
25000 Corporate Center, Suite 260
Cleveland, OH 44070-5310
Dr. Joseph W. Ray
Executive Director
Phone: (216) 734-0094
FAX: (216) 734-0686

Lab Description

The Great Lakes Industrial Technology Center (GLITeC) is one of six NASA Regional Technology Transfer Centers (RTTCs) which form the National Technology Transfer Network (NTTN), established by NASA to make federal technology available to American industry. The purpose of the NTTN is to provide an effective, market-oriented means of deploying technologies from the federal R&D base to meet the technology needs of the U.S. private sector.

Unique Equipment, Facilities or Services

GLITeC draws on federal laboratories, universities, and state and Federal technology application centers to match client needs with appropriate technical solutions. To better serve the Great Lakes region, GLITeC also maintains a network of affiliates in each of the Great Lakes states to provide local relationships and insight into state programs and industry needs. GLITeC offers tailored technology consulting and commercialization assistance within three basic types of services: Technical Assistance, Technology Management, and Technology Commercialization.

Technical Assistance

Technical assistance services provide solutions to specific problems and usually involve matching a need with an appropriate technical solution. Services can range from identifying the appropriate technology or technical expert to assembling an interdisciplinary team to identify and evaluate alternative solutions.

Technology Management

Technology Management services are designed to help draw on technology as business opportunities. GLITeC can locate potentially relevant technology and technical expertise, produce associated feasibility and market studies, and assess alternative applications for existing technology. Individual projects are tailored to meet specific client requirements. GLITeC's Business and Technology Planning Services integrate the identification of technology requirements and opportunities, the evaluation of technology resources, and planning for diversifications or growth.

Technology Needs Analyses help define new technology needs or opportunities, and develop plans for acquiring and implementing technology to improve competitiveness and promote growth and diversification. Technology Evaluation Services start with a specific technology or technical concept and look for marketable applications or products, including the identification of alternative commercial applications and the assessment of technical feasibility and market potential for each application. Diversification Planning helps identify appropriate new product opportunities, locates relevant technology, and conducts associated product and market assessments.

Technology Commercialization

Technology Commercialization services are directed at acquisition and adaptation of technology for commercial applications. This includes licensing assistance, CRADA/SAA assistance, and SBIR assistance. GLITeC also provides technology development services aimed at adapting federal technology for commercial application. These include: applications projects to demonstrate the feasibility of a technology in a specific commercial application; targeted technology development projects to adapt technology for alternative applications; and product development assistance.

Technology Transfer Intermediaries

Wisconsin

Technology Clearinghouse Services
The Technology Clearinghouse provides assistance to Wisconsin businesses in accessing state and federal technology resources. These services include:

- Locating appropriate research personnel in the state's universities and technical colleges to assist with research projects.
- Providing information on financial resources to assist with research projects.
- Providing access to databases through which businesses can obtain scientific, economic, technical and market data.
- Providing information on the Defense Conversion Initiative, a multi-year program that will provide up to $20 billion for technology development, technology deployment and military and civilian worker training.
- Providing access to contacts and technology information of the federal laboratories.

Technology Clearinghouse
Division of Policy and Information
Wisconsin Department of Development
P.O. Box 7970
Madison, WI 53707
Ms. Louie Rech
Technology Development Coordinator
Phone: (608) 267-9382
FAX: (608) 267-0436

Other Services

The Department of Development has a Manufacturing Assessment Service program. Under this program, a team of people from the Department, the Vocational, Technical and Adult Education system and Milwaukee School of Engineering visit small and medium-sized manufacturing companies to assess their needs and made recommendations in order for them to stay competitive. The assessment covers aspects of the business including human resources, technology, finance and marketing.

The University of Wisconsin-Stout, School of Industry and Technology, has a Manufacturing Technology Transfer program. This program provides three primary services: (1) Assessment of current manufacturing operations, technologies and training needs. (2) Written recommendations for improvements in the use of existing technologies, the implementation of new ones and the improvement of job performance through focused training and educational seminar. (3) Arrangements for managerial and technical experts to assist with implementation of recommendations.

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